Subterranea

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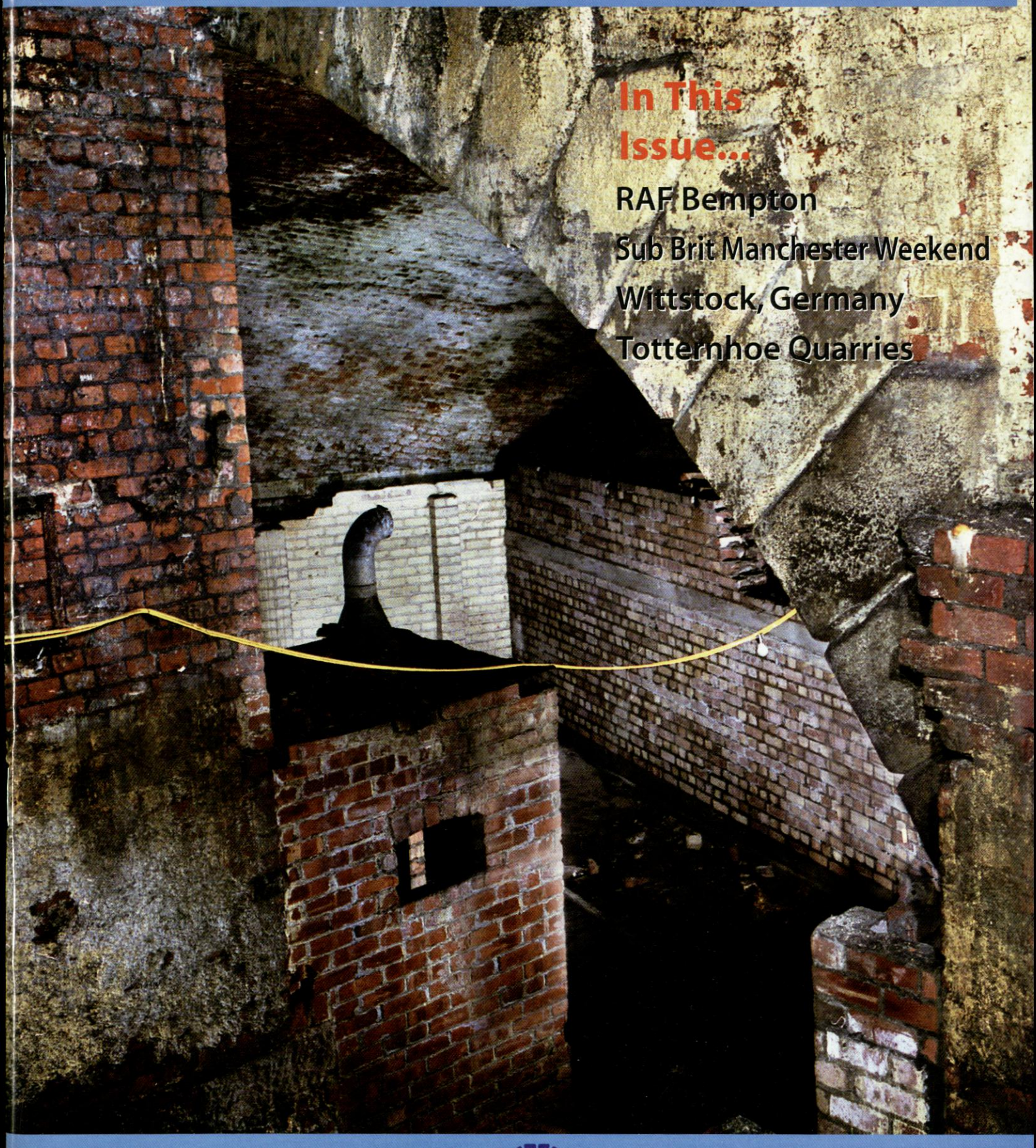

In This Issue...

RAF Bempton

Sub Brit Manchester Weekend

Wittstock, Germany

Totternhoe Quarries

Subterranea Britannica is a society devoted to the study of man-made and man-used underground structures and the archaeology of the Cold War. The society is open to all and its membership includes all walks of life. Members are invited to contribute to this magazine even if this just means sending very welcome snippets from newspapers and magazines.

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Front cover photo: The east portal of the Manchester & Salford Junction Canal in 1994. The east end of the canal was filled in after 1872. In 1899 a Great Northern Railway goods depot was built above the tunnel extending beyond the east portal which is now more than 25 feet underground. The steps were added during WWII when the tunnel was used as an air-raid shelter. A shelter warden's post is seen at the bottom of the steps. Photo Nick Catford

Back page upper: The track-telling room well at Bempton rotor radar station in 1998. The remnants of the Kelvin Hughes photographic display unit can be seen. The well was known as 'the udder'. It contained two Photographic Display System projectors and attendant control cabinets. There was a small darkroom along the end wall used for loading the 35mm film into cassettes for use on the projectors and for storing and preparing the photochemicals. Photo Nick Catford

Back page lower: Sub Brit members dressed and ready to go into the 1848 Standedge railway tunnel during the 2011 Manchester weekend. Photo Martin Dixon

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Newsletters of Subterranea Britannica are published by the committee of Subterranea Britannica. Original articles, book reviews, press cuttings, extracts from books and journals, letters to the Editor etc are welcome. However the Editor reserves the right not to publish material without giving a reason.

The committee of Subterranea Britannica and the Editor do not necessarily agree with any views expressed and cannot always check the accuracy of any material sent in.

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Chairman's Welcome

Martin Dixon

In the last edition of *Subterranea*, we announced that Subterranea Britannica had been formally registered as a charity with the Charity Commission. Hot (well, warm!) on the heels of this is the news that HM Revenue and Customs have accepted our application to be registered for Gift Aid.

This means that Sub Brit is able to reclaim tax on subscriptions and donations to the society, provided that the member/donor is a UK taxpayer. Many members have already given their approval for Sub Brit to reclaim tax by either completing our online declaration or by responding to a paper request.

If you haven't already made a Gift Aid declaration, then please do consider making one. There is absolutely **no cost to the individual** but Sub Brit benefits by 25p in every pound donated. We recognise that a number of members (especially younger, older and overseas members) may not be UK taxpayers so thank you for your understanding while we hassle others!

The Committee discussed how to make best use of this Gift Aid 'windfall' and felt that we should use the money for new projects rather than just add to our reserves or reduce subscription rates. One idea is to use some of the money to help accelerate the revamping of our website. Another thought is to ask members to nominate worthy projects such as research, publication or preservation. More on this in due course.

Whilst on financial matters, I'd like to thank Sue Monsell who stands down as Sub Brit's Treasurer at the end of December. As you can imagine, Sue has put in huge amounts of work, mostly behind the scenes, to keep our finances in good order. In particular she has steered us through the process of becoming a not-for-profit company and achieving charitable status. We all owe Sue a huge debt of gratitude. And a very warm welcome to Tony Radstone who has volunteered to become our new Treasurer from January 2012.

Looking back and reflecting on 2011, as well as many successful Sub Brit underground trips, I've enjoyed three personal visits in particular.

Firstly, after many years on the 'must visit' list, a trip to the immense Wieliczka salt mine in Poland. The site is probably and justifiably the most visited underground site in the world (transport systems aside) with around 1.2 million visitors a year (UK leaders are the Churchill Cabinet War Rooms and Dover Castle Tunnels with about 300,000 visitors each).

The historic salt mine is a short distance from Krakow which is well served by affordable flights from across the UK. Wieliczka is a UNESCO World Heritage Site and as well as the deep mine itself, a splendid museum, and even a bar, are sited 135 metres underground alongside the better known St Kinga's Chapel.

On a different scale is the Tunnellers' Memorial at Givenchy-lès-la-Bassée in northern France. This was erected in 2010 through donations and the hard work of Peter Barton and stands as a memorial to all tunnellers of World War I.

It particularly commemorates the bravery of William Hackett VC – the only tunneller to be awarded the Victoria Cross. Sapper Hackett refused to leave his trapped fellow miner Thomas Collins after the tunnel they were in collapsed following the explosion of a German mine. Hackett selflessly stayed behind even when a rescue passage was dug but after a further collapse both were entombed for eternity.

Closer to home, Sub Brit was invited by the National Trust to survey the water supply tunnels at Coleshill near Swindon which date from around 1745. Although Coleshill House – perhaps most famous as the training site for Auxiliary Units in WWII – burnt down in the 1950s, the tunnels remain. The visit is described in more detail elsewhere in this edition of *Subterranea* but it was a great privilege to explore over 300 metres of tunnel, which still feed water into a brick-lined underground reservoir.

Whether you like your sites large or small, off the beaten track or better known, I hope you have managed to see lots during the year. Particular thanks to those who have invited others on their trips and who have written up their visits for *Subterranea.*

With Best Wishes for a Happy Christmas and Good Health and Fortune in 2012.

chairman@subbrit.org.uk

Hack Green Open Day Saturday 17 March 2012

This will be the 14th year that Hack Green has been open for Sub Brit members.
The early warning siren will be activated and the massive Marconi radar array will be operational all day;
the bunker will be disconnected from the national grid and will be running in full 'Fallout' operational condition.
The cost is £32 per person which includes entry to the bunker complex all day, presentations and a buffet lunch.
There is an optional evening tour of the Stockport Air-Raid Shelters, including an underground picnic (£16 extra charge).
Organised by and proceeds to the Hack Green Bunker.
To book, please find the booking form on the Sub Brit website.
For more information phone: 01270 623353 or email: coldwar@hackgreen.co.uk
Or see the website: www.hackgreen.co.uk

Notes on the Committee Meeting held on 8 October 2011

Committee Membership

Hugh Ainsley has resigned from the committee, we thanked him for his work. Tony Radstone has been co-opted as Treasurer elect and will work closely with Sue Monsell following her announcement to standdown as Treasurer at the end of 2011.

Gift Aid

Subterranea Britannica was granted charitable status in June, and is now able to claim Gift Aid retrospectively from 2007. Everyone on the current membership database will receive either an e-mail message or a letter asking them to confirm that they agree to their payments being registered under the Gift Aid scheme. There is no additional cost for members, but Sub Brit can claim valuable additional funds from the Government. The committee will consider the best use that could be made of the additional funds that would be generated under the scheme, with the emphasis on improvements to the service provided to members and to the public.

Website & Social Media

Work is continuing on improvements to the Subterranea Britannica website, which is seen as the key point of contact for both members and the general public. Further development work will be undertaken on the new media, which are seen as complementary to existing communication channels.

Day Meetings

The Spring Meeting/AGM will be held on 21 April 2012 at Imperial College; the Autumn meeting is likely to be held in Liverpool (further details of both meetings to be advised later).

Visits

The 2011 visits to Sweden, Manchester, Devon and Neatishead were all very well supported, and have attracted favourable comments from those who attended. For 2012, visits are already planned to Jersey (May), Kelvedon Hatch (July) and Sussex (September). Any other visits will be publicised nearer the time.

Membership

Nick Catford reported that Sub Brit had a total of 1076 members (including 23 overseas) at the beginning of October, and renewals and applications to join are still being received.

Clothing

The possibility of new design Sub Brit clothing (sweatshirts and caps) is being investigated. Once design and costs are finalised, members will be invited to place orders.

Next Committee Meeting

Will be held on 28 January 2012. Members who wish to raise any matters for discussion should send details to the Secretary by 1 January 2012.

SUBTERRANEA BRITANNICA DIARY

Summary of Forthcoming Events 2012

Sub Brit specific events

28 January SB Committee meeting

1 March Copy deadline for *Subterranea 29*

March Email booking for Spring Conference opens

17 March Hack Green open for SB members

21 April SB Spring Conference and AGM

End April *Subterranea 29* published

4 - 7 May SB Study Tour JERSEY

23 June (tbc) SB Committee Meeting

1 July Copy deadline for *Subterranea 30*

15 July **NEW** SB members Day at Kelvedon Hatch

End August *Subterranea 30* published

August/September 2012 SB UK Visits weekend – Sussex

13 - 14 October SB Autumn Conference and visits – Liverpool

1 November Copy deadline for *Subterranea 31*

Other underground-related events

28 April SERIAC conference, St Bartholomew's School, Newbury www.biag.org.uk

29 June - 1 July NAMHO conference Alderley Edge www.derbyscc.org.uk/namhoconference2012

July Coleshill Auxiliary Unit Archaeology Dig (tbc)

14 - 29 July Festival of British Archaeology http://festival.britarch.ac.uk

10 - 16 August AIA Conference, Chelmsford www.industrial-archaeology.org.uk

6 - 9 September Heritage Open Days

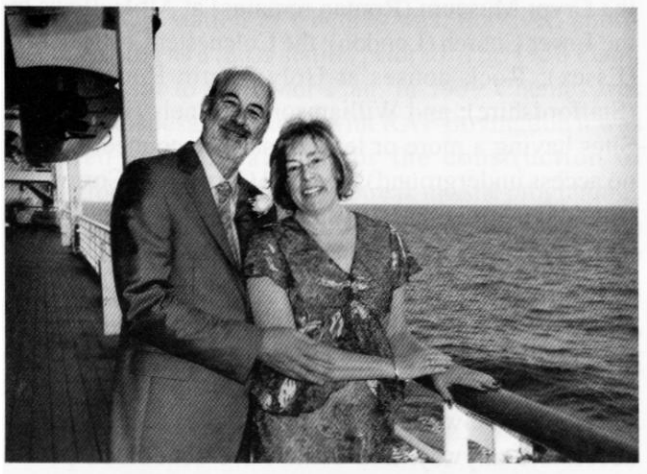
14 - 16 Sept (tbc) London Open House weekend

For more information, email info@subbrit.co.uk
or contact the Society concerned

NEWS – SUB BRIT SOCIAL

Marriage on the High Seas

Many members will know that our Chairman and Vice Chair – Martin Dixon and Linda Bartlett – have been together for over thirty years. In September they tied the knot by getting married on a cruise ship at sea. The location was the middle of the Adriatic and the couple hope that the nearest port (Split) isn't prophetic! Following their return to terra firma they held a party which included a number of Sub Brit friends; we offer our congratulations and wish them many years of happiness together both above and below ground.



NEWS – ARCHAEOLOGY

Rosmarkie Cave Project established

On the south shore of the Black Isle (north of Inverness on the Moray Firth), and just up the coast from Rosemarkie, are about twenty old sea caves. Some of these are large and dry and all are at least three metres above the high-water mark. For the past 7,000 years, due to isostatic recovery after the last Ice Age, the land has been rising, while the sea has receded. The old, raised shoreline can be seen round most of the Black Isle; Cromarty, Avoch and Rosemarkie all sit on raised beaches, as do the caves.

The caves at Rosemarkie are largely unexplored but it is believed that many of them could have been used in historic and possibly prehistoric times. The Rosemarkie Caves Project was set up to research the archaeology of these caves. The project is a partnership between people living locally and the North of Scotland Archaeological Society (NOSAS), assisted and advised by professional archaeologists.

SOURCE: Rosemarkie Cave Project website
www.spanglefish.com/rosemarkiecavesproject/

Underground sites and mainstream archaeology and history

The exploration and study of underground space has hitherto been widely regarded as a distinctly eccentric if not plain daft and dangerous occupation. And one attracting eccentric and ill-informed devotees given to improbable theories. Few self-respecting British parishes lack rumours or tall tales of secret tunnels, often supposedly linking castles, churches, monasteries, palaces and the like, with imagined tunnels through waterlogged chalk or gravels! Where these tunnels exist they are, in fact, often drains – made big enough to be cleaned out by sending men (or maybe children) down them with shovels and brushes.

One problem has been that although both cavers and mine explorers have done much excellent work in exploration, photography and surveying, the results (if published at all) appear in obscure local club magazines with very limited circulation (often restricted to a very small membership). But things are changing. Good underground recording and research is now being published in the mainstream archaeological literature, not just in limited-circulation caving club publications.

The current year (2011) has seen a substantial move in the right direction. The published report of Lynn Willies *et al.* on their archaeological and historical research concerning 18 hectares of underground building-stone quarries at Combe Down, Bath, is a landmark in the development of underground archaeology in Britain and its publication. And one of Britain's leading nationally distributed archaeological magazines *Current Archaeology* (www.archaeology.co.uk) has carried main feature articles on underground archaeology in two or three recent issues.

English Heritage's support for our successful application for registration as a charity, thanks to the sterling efforts of our leadership team (now united as Linda and Martin Dixon), can be seen as but one of a number of signs that the archaeological and historical communities are beginning to take underground space and its exploration and study more seriously.

Disappointingly, though, although English Heritage launched its Industrial Heritage at Risk Project on 19 October 2011, and devoted a whole issue of its periodical *Conservation Bulletin* (issue 67, Autumn 2011) to this theme, there was little in it devoted to mining, underground quarrying, or tunnelling. However, they were co-sponsors of the Nottingham Caves Survey project, and are funding NAMHO to produce a Research Framework of mine and quarry archaeology in England.

Contents of a sealed crypt in Warwickshire

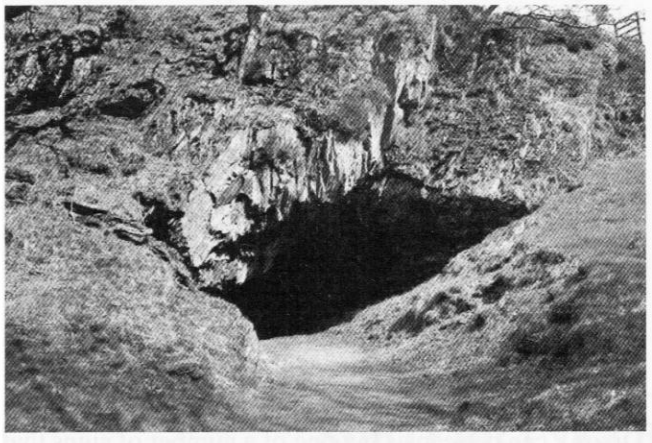
The Churches Conservation Trust's conservation and archaeology team has been investigating a crypt, sealed since the eighteenth century, at the parish church at Billesley, Warwickshire. After 'squeezing through a tiny opening' they found five stone or lead coffins, and the remains of a child's wooden coffin, dating from the early 1700s. The coffins were those of members of the Whalley family, owners of Billesley Manor until it was sold in 1721. The church has Shakespearean connections: the playwright's granddaughter was married there.

SOURCE: ANON, 2011, Wedding cheer at a Burial Feast. *Current Archaeology* 22(8)(260), 10 - 11 [Warwickshire]

Dolaucothi gold mine, Carmarthenshire

The only reported evidence for Roman gold mining in Wales is from Dolaucothi, where opencast pits, adits, shafts, and water supply leats and reservoirs have been recorded. Although some pre-Roman mining is suspected, the main features appear to date from about 150 AD. However, some mining recommenced in the nineteenth century and continued until 1938. Part of an 'oak drainage wheel' found underground in the 1930s has been radio-carbon dated to 2040 +/- 70 years before present, confirming deep mining in the first or second century AD. The site is currently managed by the National Trust.

SOURCE: BREWER, Richard, 2011, Dolaucothi gold mine and Pumsaint Roman fort. IN: John R. Kenyon and Patrick Ottaway: *Southwest Wales: Pembrokeshire and western Carmarthenshire,* 26 – 27 [Royal Archaeological Institute Report and Proceedings of the 156th Summer Meeting / Supplement to the *Archaeological Journal* 167]



Dolaucothi mine adit

NEWS – CONSERVATION AND HERITAGE

Introducing the underground to the public

There are two nationwide events each year at which Subterranea Britannica and other societies dedicated to the archaeology and history of underground space can publicise themselves for free. Sadly, hitherto, underground sites and sites with an underground dimension (not necessarily accessible) have barely featured in either.

Heritage Open Day events (free to all) are publicised nationally, and the similar London Open House Days are advertised throughout the capital. And the Festival of British Archaeology, organised by the Council for British Archaeology, is also advertised nationally. Advertising (at no cost to participating groups) is through websites and through nationally or locally published hard copy guides.

In 2011 the dates were 16 to 31 July for the Festival of British Archaeology; Heritage Open Days 8 to 11 September; and London Open House Days the weekend of 17 – 18 September. The corresponding dates for next year will be Saturday 14 to Sunday 29 July 2012 for the Festival; Thursday 6 – Sunday 9 September (Heritage Open Days); and the weekend of 15 – 16 September (London Open House).

So there are two messages. Find out about places not usually open to the public which you can visit. And if you are an officer of a relevant society, or in charge of an interesting site, and looking to showcase your work or site, sign up for free advertising for your event or site next year. Very few underground or underground-related sites were advertised to the public in 2011 and previous years. Praiseworthy exceptions were the Friends of Williamson's Tunnels at Liverpool, and the Wealden Cave and Mine Society at Reigate (Surrey).

Festival of British Archaeology sites open to the public in 2011 included a Winchelsea Cellar tour (East Sussex); the Crypt Museum (Roman remains) at All Hallows by the Tower Church (London); the Colchester Castle cellars (Essex); Rock houses at Holy Austin Rock, Kinver (Staffordshire); and Williamson's Tunnels (Liverpool). Sites having a more or less subsurface connection (but no access underground) included Carn Brea (Cornwall); Cheddar (Somerset); East Harptree (Somerset); the Coombe Conduit House at Kingston-upon-Thames (Surrey); the London Canal Museum ice-well (London); Hough Mill Colliery (Leicestershire); Snibston Colliery at Coalville (Leicestershire); Middleton collieries at Leeds (West Yorkshire) and the Great Orme copper mines at Llandudno (Gwynedd). Some of these are publicly accessible anyway, and some have scheduled public underground visits, but the praiseworthy feature of the Festival events is the opportunity to meet archaeologists and other experts on site rather than the usual tour guides.

Details: Council for British Archaeology – Festival of British Archaeology: www.britarch.ac.uk and www.archaeologyfestival.org.uk

Heritage crime

Heritage crime is defined as any activity that 'harms the value of England's heritage assets and their settings to this and future generations'. It includes the alteration or demolition of Listed Buildings; damage by fire, graffiti and off-road vehicles; unlawful excavation and removal of artefacts; architectural theft; the theft of copper, lead, stone, etc. Collecting souvenirs from underground sites for personal satisfaction is, at least, offensive and is legally an offence if the site is a designated heritage asset such as a Scheduled Ancient Monument, Listed Building, Conservation Area, Registered Battlefield or Park or Garden. Additionally, undesignated buildings and sites of acknowledged heritage value are covered.

An Alliance to Reduce Crime Against Heritage (ARCH) has been set up by the Association of Chief Police Officers, the Crown Prosecution Service, English Heritage, the Council for British Archaeology, and others.

SOURCE: COUNCIL FOR BRITISH ARCHAEOLOGY, 2011, New alliance to fight heritage crime. *CBA Newsletter* 14 (April 2011), 4 – 5; and ANON, 2011, Measures to combat heritage crime. *Current Archaeology* 22(2)(254), page 11.

NEWS – MILITARY AND DEFENCE

RAF Chenies demolished

In 1954 RAF Chenies was opened as part of Phase 4 of the Rotor Radar programme. Phase 4 comprised five R6 semi-submerged protected stations and nine less-substantial R8 stations. Normally, stations on the east side of the country would be protected but Chenies being in the centre of the country near Chorleywood in Buckinghamshire was provided with a prefabricated *Seco* R8 structure built of wood fibre and asbestos panels. Of the nine R8s, Chenies was the only station to be fully operational.

The ROTOR station at Chenies was, however, short-lived, closing as a radar station prior to 'The 1958 Plan', the successor to the Rotor Plan. In 1959 Chenies was awaiting disposal but along with RAF Bovingdon it was selected as an ideal site for the construction of underground silos for the Blue Streak missile programme. Disposal proceedings were immediately stopped but the project was later cancelled. The station remained in RAF hands however, becoming a Strike Command communications facility. In the mid-1980s Chenies also took on a new role as part of the Gandalf Project when a new radar was installed for the Met Office.

The pre-fabricated (Seco) R8 building. Photo Nick Catford

In the summer of 2004 the station was listed for disposal. The Strike Command radio station had closed and the mast had been sold to NTL. The Met Office radar station remained in use enclosed within a new compound. As part of the sale agreement, the R8 structure had to be demolished by the new owner even though it was the only remaining R8 building in anything like complete original condition. A section of the R8 at Wick (Scotland) still survives in industrial use while all the other R8 structures have been demolished. Because of the unique nature of the building, there were numerous requests that it should be listed but sadly this did not happen.

After repeated requests to visit Chenies were refused on health and safety grounds, the MOD did allow a small party from Sub Brit to record the site prior to sale. After the sale, the new owner agreed to a members' open day which was well attended despite torrential rain. The building and radio mast were demolished in the autumn of 2011 and it is assumed that the site will be returned to agriculture.

SOURCE: Subterranea Britannica website and personal observation by SB member Hugh Ainsley

SAS Squads to be based in London bunker during the Olympics

SAS squads will be based in a secret riverside bunker by the Thames for the London Olympics to combat terrorist threats more effectively. The Special Air Service teams will use high-speed rigid inflatable boats to avoid traffic and increase their response speed.

The special forces troopers have been training for months against the potential threat of a Mumbai-style attack, in which terrorists seize hotels or other civilian targets and defend them against the authorities. A source told the *Sun* newspaper: "All scenarios are being anticipated. London will be protected like never before – and the message is clear: if anyone is fool enough to try to endanger the public at these Games they will be met with the swiftest retribution by the best equipped troops of our most elite fighting units. Troops can deploy by air and water and be on site in moments. Then you've got force on the ground while the situation is monitored by the air."

SOURCE: *The Sun*

Nuclear bunker uncovered in Trafford, Greater Manchester

Builders have uncovered a 30-year-old nuclear bunker under Trafford town hall as part of its multi-million pound renovation.

Trafford bunker during demolition

It is now seeing the light of day as the offices above are demolished. The 10,000sq ft fallout shelter was designed as part of the council's 1980s extension to the town hall. At the time, its inclusion in the plans caused outrage among anti-nuclear campaigners, who furiously attacked it as a waste of money. Neighbouring Manchester was then a nuclear-free zone and a CND doorstep poll found 86 percent of Trafford residents opposed the shelter. Anti-nuclear debate raged in the pages of newspapers and campaigners handed a petition in to the council.

But the town council said it was an 'essential' part of its civil defence against an all-out attack. The offices opened

in 1983, complete with the fully-functioning nuclear bunker which was, in reality, a conversion of an existing basement. It was fitted with standard Home Office blast doors, air filtration plant, a standby generator and a radio room. It also housed large stocks of dried food.

In recent years it has been used for storage but prior to demolition it was found to be empty apart from the generator and air filtration system.

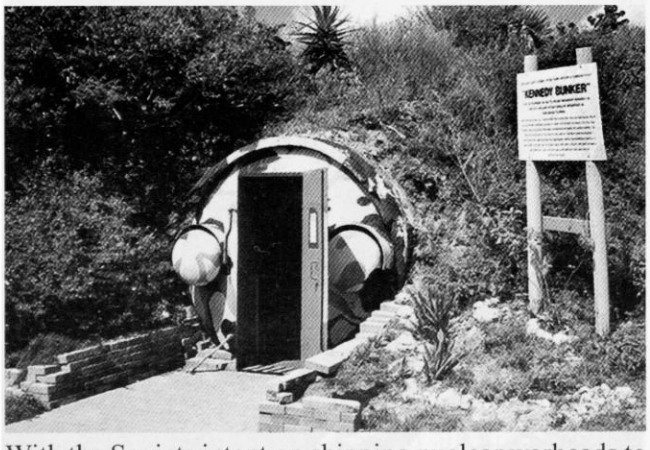
SOURCE: *Manchester Evening News,* 9 November 2011.

President Kennedy's Florida bunker

During the early 1960s when President John F. Kennedy was facing a series of nail-biting face-offs, even the Soviets recommended a fallout shelter for all Americans "as rapidly as possible" in an October 1961 speech. Two months later, Kennedy was presented with his own top-secret tropical bomb shelter off Palm Beach, Florida.

Few even know it is here, but some local residents believe that the bunker is a must-see attraction that could put Peanut Island on the map. Termed the "Detachment Hotel" in documents, the fallout shelter here was built by members of the US Navy construction battalions in less than two weeks at the end of December 1961. Deftly camouflaged by trees, it was hard to spot. If people asked, they would be told it was a munitions depot, nothing more. Kennedy visited the bunker twice during a drill.

"The government never declared it existed until 1974," said Anthony Miller, a member of the executive board of the Palm Beach Maritime Museum who run tours of the bunker.



With the Soviets intent on shipping nuclear warheads to nearby Cuba, Kennedy was assured of the need for a radiation-proof haven a mere five-minute helicopter hop from his oceanfront winter home on millionaire's row in Palm Beach. To ensure the president's safety during the summer, when he visited the Kennedy compound on Hyannis Port, Mass., a sister shelter was built on Nantucket Island in 1961; it has never been open to the public.

The Florida bunker, which fell into disrepair in the 1990s, was cleaned up and has been open for tours since 1999, shortly after the museum leased the land. Inside, to the left of a long corrugated tunnel, lies the decontamination shower, the first hint that the possibility of a nuclear showdown was not believed to be so far-fetched. Eleven months after the shelter was built, the Cuban Missile Crisis erupted.

The shelter is decorated as it was then, more or less, with replica pieces and a presidential seal. There is room enough to hold 30 people on 15 metal bunk beds and supplies for around 30 days. A radio transmitter sits on a desk in a corner. Shelves are stocked with giant tins of waterless hand cleaner, cans lined with lead that contained drinking water (no longer advisable), deodorant to clean clothes, petroleum jelly, castor oil and ample Army rations. Gas masks sit at the ready. An escape hatch lies at one end, just in case the Russians were coming. In one corner, there is a rocking chair, a nod to Kennedy's bad back.

But just how long the museum can keep operating the bunker is another matter. The museum has been running at a loss for many years.

See Palm Beach Maritime Museum website www.pbmm.org/Page1.htm

SOURCE: *New York Times,* 1 October 2011.

New Zealand fashion label is launched in a WWII bunker

The raw, edgy, feel of a World War II bunker makes it the perfect place for the New Zealand based fashion label UNDONE to launch.

The high-end women's street-wear label, which channels the attraction of opposites, was established by Otago Polytechnic graduates Rachel Webb and Elise Barnes earlier this year. "We describe it as a collaboration based on the opposites of design ... we bring a feminine and androgynous design to the table," Miss Webb said.

Their debut collection was launched on 23 September this year in a WWII bunker underneath their Bond Street studio in Dunedin. The bunker was excavated beneath the 1901 structure in 1941, after the bombing of Pearl Harbour, as a refuge for the building's office workers. A full water reticulation system to allow water to be pumped in and out of the space, along with shelving for rations, still remains.

SOURCE: *Otago Daily Times,* 23 September 2011.

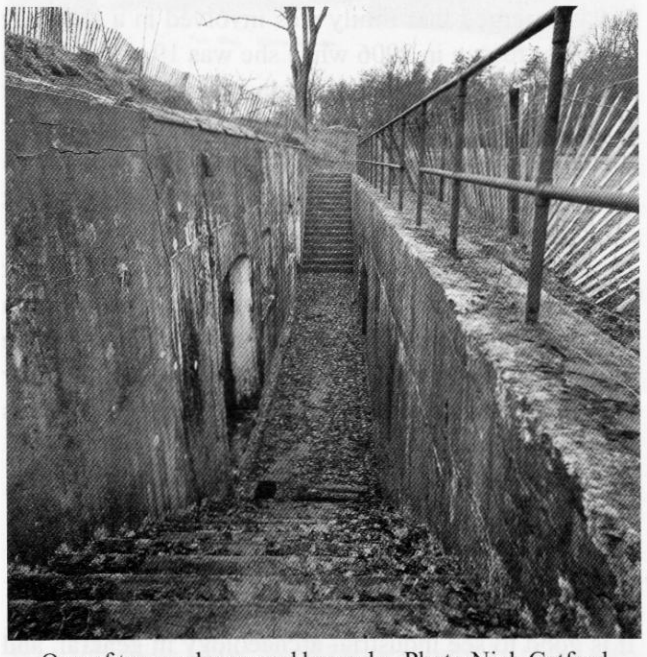
Designers Rachel Webb (left) and Elise Barnes in the bunker

Essex, Kent and Surrey's North Downs 'forts'

Paul W. SOWAN

During the later 1890s a line of thirteen 'forts' was constructed from North Weald near Brentwood in Essex via the Darent Valley (Kent) and the North Downs as far west as the neighbourhood of Guildford (Surrey). These structures, more correctly referred to as Mobilisation Centres, or the London Defence Positions, were erected, in Surrey, on the crest of the Chalk escarpment at Woldingham, Fosterdown (between Caterham and Godstone), Merstham East, Reigate Hill, Betchworth, Box Hill, Denbies (above Dorking) and Pewley Hill and Henley Grove near Guildford.

The Box Hill and Reigate 'forts' (both now owned by the National Trust) are easily visible from public rights of way. Both have semi-subterranean ammunition stores. At Reigate, there is unrestricted public access to the site, and guided tours including the two semi-subterranean chambers are arranged from time to time, for which an entry fee is charged (even to NT members). Merstham East is in private ownership and derelict. There was to have been a Merstham West, thus forming a pair to protect the important transport links through the Merstham Gap, but building work never started. Linked pairs do exist for the protection of the Mole and Wey river gaps.



One of two underground barracks. Photo Nick Catford

An authoritative discussion of the construction and purpose of these 'forts' has just been published in the Fortress Study Group's journal *Fort*. The Reigate 'fort' has been described in some detail in a recent issue of *Subterranea*.

Although the dozen or so 'forts' are generally said to have been built to counter a possible invasion by France (that is certainly the impression given by the National Trust's booklet about Reigate Fort), Dennis Turner, a leading archaeologist and historian of Reigate, has now suggested the real perceived threat was from Germany, and is writing a booklet on this theme.

The (entirely imagined) 'Battle of Dorking', about which much was published and said in the 1870s, supposedly was a product of the brain of an Army chief anxious for more public pressure on central Government for increased military expenditure!

HAMILTON-BAILLIE, John Robert Edward [1919–2003], 2009, A history of fortification in the UK, 1870 to 1955. *Fort* 31 (for 2003), 6 – 40.

TURNER, Dennis, 2011, Surrey's North Downs 'Forts' again. *Bull. Holmesdale Natural History Club* 99, page 5.

World War II poster discovered in the Tunnel Road West air-raid shelter, Reigate

Paul W. SOWAN

The sharp eyes of a member of the Wealden Cave and Mine Society spotted the following notice on a brick wall in what is now the shooting range of a rifle club in the Tunnel Road West sand mines at Reigate:

This shelter is not gas proof.

Always bring your gas mask with you.

This is printed in dark blue ink on deteriorating paper. The mine has had a number of uses since mining ceased probably in or soon after 1858, in which year there was a major roof fall resulting in what is now better known as an attractively planted 'sunken garden' (in reality a mining subsidence feature) in the Castle Grounds above. These have included storage for alcoholic beverages, storage for Army purposes in World War I, an air-raid shelter in World War II, and, now, a rifle range. The oldest graffito recorded in the mine is a prominently and carefully carved inscription HAA 1862 which might relate to the mine's owner, operator, or closure date.

The Wealden Cave and Mine Society, with the permission of the Rifle Club, open the TRW mine to the public on four summer Saturdays each year. The remains of the notice are on a west-facing brick wall at the east end of the long east-west gallery just inside the entrance.

Amongst other relics of World War II vintage are traces of the main and emergency entrance / exit staircases, although their timber work has now disappeared. There are also World War II period dated graffiti on the walls, and a depiction of Adolph Hitler.

Water, food storage and cooking, lighting heating and ventilation, and sanitation in fortified places

The September 2011 issue of *Casemate*, published by the Fortress Study Group, contains a four-page article about 'necessaries' in UK forts and batteries. Human physiology, and physiological needs, have hardly changed over a couple of million years of evolution, whereas human ingenuity has of course advanced remarkably in the last few centuries.

This presents some data relating to water supply and storage, food storage and cooking, heating, lighting and ventilation, and sanitation in fortified military

establishments. The same considerations, of course, also apply to older structures such as Norman and later medieval castles. Perhaps the storage and disposal of the dead might also have been considered?

SOURCE: GOODWIN, John, 2011, 'Necessaries' in UK forts and batteries. *Casemate* 92, 13 - 16.

NEWS – MINING

NAMHO Conferences

NAMHO (the National Association of Mining History Organisations) has mining history organisations, rather then individuals, as members, amongst them Subterranea Britannica. Paul Sowan is the Sub Brit representative.

Under the overall NAMHO umbrella, individual member societies take it in turns to host a mining history conference each year. These are generally quite ambitious affairs, offering a wide choice of lectures and field visits at all levels of technical difficulty from gentle surface strolls to see mining landscapes to the descent of deep vertical shafts calling for all the right equipment and techniques (and stamina). Usually a venue is chosen offering both indoor accommodation and a camping option. A real ale bar is another usual feature, and a Saturday evening dinner. The main conference programme is over a weekend, but there are usually additional field visits for two or three days before or after the main event. And of course Mike Moore's bookstall is a wonderful source of interesting new and secondhand publications you might otherwise never have known about.

The 2011 Conference was based at the Field Studies Council's field centre at Preston Montford, a short way west of Shrewsbury. It was hosted by the Shropshire Caving and Mining Club, and allied local groups. There was a splendid choice of visits and lectures, and a beer specially brewed for the occasion. The meals laid on at the Field Centre were outstandingly good quality, quantity and value. And the weather was kind.

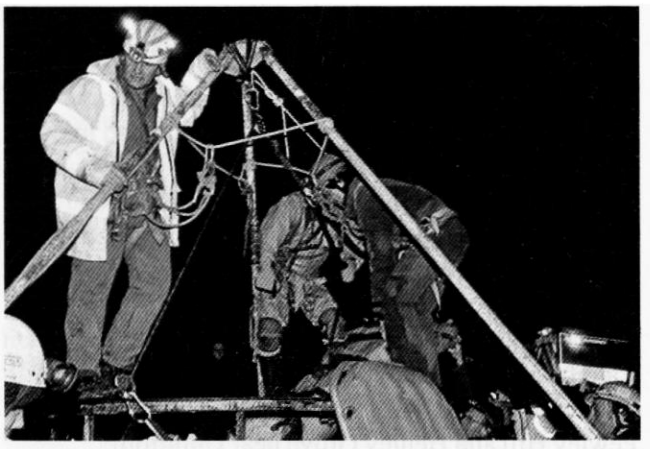
The 2012 Conference was to have been at Nenthead, near Alston in the North Pennines, on the weekend 26 – 27 May, but dire economic problems have enforced a change of plan: it now looks likely to be at Alderley Edge, Cheshire, instead, possibly the same date. There is a NAMHO website where you can get the latest news.

Injured caver rescued from Shropshire mine

In the evening of 16 September 2011, Emily Sellick (24), from Kingsbridge, Devon, was deep underground in Snailbeach Lead Mine, near Minsterley, Shropshire, when she had an epileptic seizure, fell and injured her back. She landed in a side chamber and began to slip in and out of consciousness. Fortunately she had medication for her epilepsy which the group quickly administered.

The alarm was raised by her companions, two of whom took 45 minutes to climb back to the surface and alert the emergency services.

More than 50 members of the Midlands Cave Rescue Organisation from all over the Midlands and as far away as South Wales joined West Midlands Ambulance Service staff to help with the rescue.



The tripod over Chapel shaft. Photo Rose Pearce

Due to the nature of the woman's condition and the unusual location, a HART (Hazardous Area Response Team) paramedic, who is trained in confined space working, went with the rescue team. They were able to bring the casualty to the surface in just over six hours. A tripod rope system was set up at the surface on Chapel shaft and the woman was winched 300 feet up with the doctor, a task which in itself took around 30 minutes, arriving at the surface at 3:30am. She was taken to the Royal Shrewsbury Hospital for treatment.

It has emerged that Emily was involved in a similarly dramatic rescue in 2006 when she was 19 years old. In that incident, she slipped in Pridhamsleigh Cavern, near Buckfastleigh, Devon, sparking a three-hour rescue operation. She was about 300 foot into the cave when she slipped while attempting to climb a small step, falling on to her back.

Due to the intricacy of the cave and her back injury, it took rescuers more than three hours to pull her out on that occasion. Following her rescue by members of the Devon Cave Rescue Organisation, Emily made it her ambition to join the group and went on to be appointed as its secretary.

SOURCE: BBC News 17 November 2011

Western Morning News 19 November 2011

Shropshire Star 21 November 2011

Archaeology of tin-mining on Dartmoor, Devon

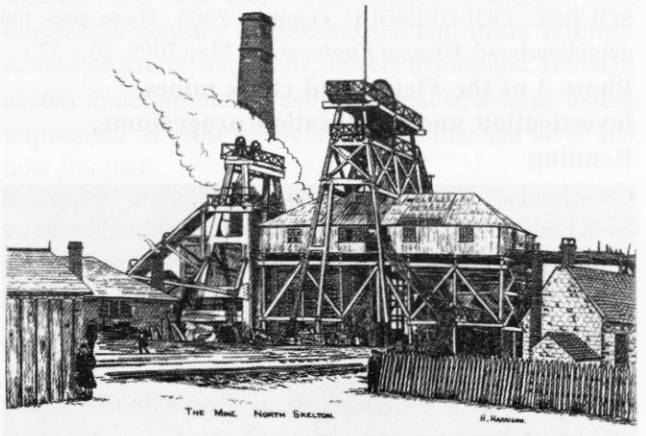
It is good to see industrial archaeology in general, and the archaeology of mining in particular, published in mainstream archaeological periodicals.

Phil Newman's new book, *The field archaeology of Dartmoor*, has drawn attention to the importance of tin mining in Devon, often overshadowed by the more widely known industry in Cornwall. Chris Catling has now offered an overview in the magazine *Current Archaeology*.

SOURCE: CATLING, Chris, 2011, Mining the Moor. *Current Archaeology* 22(8)(260), 20 – 27.

Acidic and iron-contaminated mine water at the former North Skelton Mine near Saltburn, East Yorkshire

On 18 May 1999 Saltburn Gill and its tributary Saltburn Gill Beck suffered massive pollution by slightly acidic iron-rich mine water which deposited large quantities of ochre (hydrated iron oxide) in this nature reserve and statutory Site of Special Scientific Interest, an event severely prejudicial to the ecology of the hitherto clear streams (noted amongst other things for otters and kingfishers) through relict postglacial native woodland. An additional iron load of about 180 kg per day has been estimated. A report of investigations of the cause of this unfortunate event, and of possible mitigation measures, has just been published in the Geological Society of London's fellows' magazine *Geoscientist*.



The spring yielding contaminated water bearing 1200 milligrams of dissolved iron per litre has been rated as having the second highest contaminant concentration recorded in UK mine water. It emerged at a point immediately above shallow ironstone mine workings. As the mine in question (North Skelton) had closed in 1964, well before 1 January 2000, no legal responsibility attached to current landowners or former mine operators. Field and archival investigation of the Cleveland ironstone orefield revealed a surviving open shaft which is, however, choked with debris just below the water-table. The cause of the gross contamination is not the iron silicate / iron carbonate ore itself, but the accompanying iron pyrites (iron II disulphide) which, with bacterial assistance, is oxidised and hydrolysed to iron sulphate and in turn sulphuric acid.

Why this mine water should appear only 35 years after the last mine closed has also been investigated. It appears that the North Skelton mine shaft, sunk in 1870, was lined with iron tubbing to exclude groundwater in beds above the ore seams. This water-excluding lining has probably now been corroded-through, releasing a head of eight to ten metres of water into the old mine workings. That water, collecting dissolved iron sulphate en route, has now resurfaced at Saltburn.

SOURCE: LORD, Richard, and Don MASON, 2011, Metal mines: who pays the tab? *Geoscientist* 21(6), 12 – 17.

Mining for cat litter

Although fullers' earth (the clay mineral montmorillonite) occurs widely throughout England, it has been found in economically workable deposits in only a few places, including the Maidstone district (Kent), Bedfordshire, near Bath (Somerset) and at Nutfield (Surrey). It was won by underground mining exclusively near Bath, to some extent in the nineteenth century at Nutfield, and apparently underground near Maidstone.

It is a versatile material with numerous uses ranging from cat litter to drilling muds. The Surrey deposit was protected from surface building in Surrey County Council's development plans, on the grounds that it was a 'mineral of strategic importance', although the warehouses at Nutfield, when last seen in use, seemed to contain thousands of sacks labelled 'Good kitty' in a number of European languages!

English production having now ceased, we have to rely on foreign imports of like minerals to protect English carpets and floors from incontinent cats. The imported material, mostly mined around Madrid, is the mineral sepiolite, economically exploitable deposits of which are few and far between. Crystallographic investigations of sepiolite reported in *The American Mineralogist* now seem likely to point to the feasibility of converting the much more abundant common clays, widespread worldwide, to versions with the high absorbency required to soak up the smelly excretory products of our feline population.

SOURCE: DAY, Sarah, 2011, Thinking outside the box. *Geoscientist* 21(8), page 7 [*Geoscientist* is the magazine of the Geological Society of London]

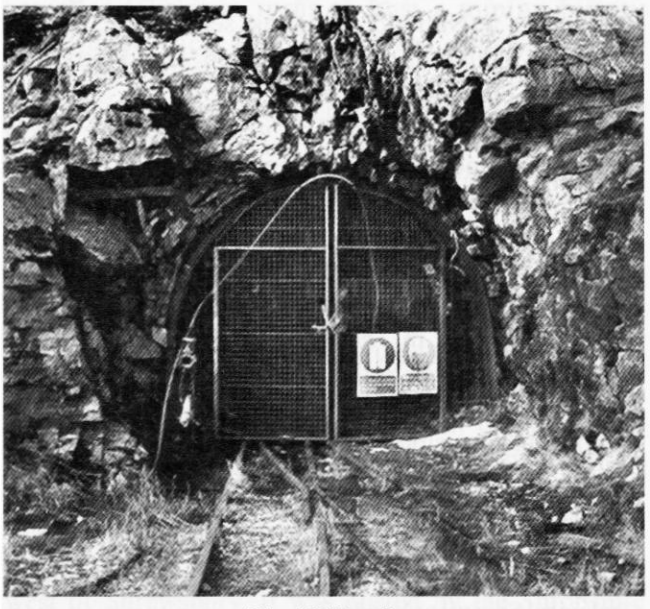
Gold mining may recommence at Tyndrum, Perthshire

Paul W. SOWAN

Gold is a singularly useless metal, although scientifically interesting in being one of only two coloured metals known (the other is copper). Pure (24 carat) gold is inconveniently soft, and almost half as dense again as lead – extremely 'heavy', in everyday language. It is neither the rarest of metals, nor the most expensive. The periodic table of the elements is littered with rarer and more expensive ones. Its one really useful attribute is its chemical unreactivity, which means in practical terms it won't tarnish or rust away.

A very restricted range of chemicals will react with it. Its other useful property is that it is incredibly malleable, so can be beaten into extraordinarily thin sheets, hence its use for gilding base metal objects, or decorating manuscripts, or lettering the covers of books. Light can be shone through gold leaf, and emerges an odd green-blue colour – a piece of useless information that might come in handy for a more than ordinarily intellectual pub quiz! My personal opinion is that gold isn't actually very attractive – vulgar perhaps, but I prefer silver!

The economics of gold mining depend on the current market price. If the price is high enough, ridiculously lean ores will repay working. Huge volumes of rock have to be processed to recover a few specks of the metal. The gold occurs either in, typically, quartz veins in ancient metamorphic rocks; or as specks in the sands and gravels that result from the erosion of such rocks. So you mine the primary ore veins, crushing the host rock and extracting precious little precious metal for every tonne processed. Or you do much the same with sands and gravels dredged from river beds. Either way, huge volumes of waste rock are left to tip to spoil. The environmental impact of all the crushed waste rock is a factor in the economics of running a gold mine.



The 1990s adit

A mine was started in Glen Cononish, near Tyndrum, in the 1980s, but abandoned when the gold price collapsed. It was bought by an Australian Company, Scotgold, in 2007 and has now been given permission by Loch Lomond and the Trossachs National Park Authority to commence industrial-scale mining. Although it is not proposed to use either cyanides or mercury in the ore processing (two long-established techniques), there is concern about the visual impact of massive waste spoil tips of crushed stone in the landscape. It is reported that a tonne of waste rock results from the extraction of enough gold to make a ring.

SOURCE: SCOTT, Kirsty, 2011, Fears for Glen after goldmine given go-ahead. Decision brings hopes of local jobs but concern for national parks environment. *The Guardian*, 31 October 2011, page 7.

Chalk mines at Hemel Hempstead, Hertfordshire

In May 2007 there was a sudden ground collapse at domestic property near the junction of East Green, Highbarns, and Pond Road, Hemel Hempstead. Where there had been a patio was now an 80-cubic-metre crater! Disturbingly, there had also been such a collapse nearby six years earlier.

Clive Edmonds of Peter Brett Associates investigated, and decided this was most likely yet another abandoned chalk mine. A hundred and two boreholes were put down, in and around the property and road junctions, resulting in the detection of forty mined cavities. Twelve cameras were lowered down some of the boreholes, and photographs taken. The mine is around 17 to 18 metres below ground level, where about six metres of clay overlies weak chalk. Mine tunnels around five metres high and three metres wide were proved.

Road traffic was diverted, and the ground stabilised at considerable expense. The published news report includes a map showing the known extent of the cavities. It has been suggested that this mine, quite possibly one of several in the area, was worked between about 1800 and 1850 for chalk to whiten paper at the Nash Mills paper manufactories on the river Gade, about 750 metres away.

SOURCE: GOLDFINGLE, Gemma, 2009, There goes the neighbourhood. *Ground Engineering*, May 2009, 26 – 27.

Phase 3 of the Field Road chalk mines investigation and stabilisation programme, Reading

On 4 January 2000 there was a major ground collapse at 6 – 8 Field Road, Reading, resulting in a 200-cubic-metre crater. The only warning had been a water mains leak earlier that day. Over ten years later, investigations and ground stabilisation continue, at a cost to date exceeding £10m.

The initial work addressed the properties immediately affected (all now repaired and reoccupied) but did not determine the entire extent of the undermined area. Phase three of the project is now investigating the solidity, or otherwise, of the ground below a further 55 households. The area investigated and treated includes Coley Hill, Coley Place, Dover Street, Field Road, Garnet Hill, and Lower Field Road, all mined cavities detected being infilled.

SOURCE: SYMES, Claire, 2011, Fixing a hole. *Ground Engineering*, October 2011, pages 16 and 18.

Natural and Mining Cavities Database

Peter Brett Associates, of Reading, manages and updates the Natural & Mining Cavities Database, containing entries for the whole of Britain. This database was initiated in 1990 in connection with the Department of the Environment's *Review of mining instability in Great Britain*.

The Review was conducted by Arup Geotechnics, and Subterranea Britannica members and others contributed data. Data is collected from published information, 'grey literature' (non-published internal reports and the like), local authorities, the British Geological Survey and other sources. The database is consulted by insurers, local authorities, and potential site developers or purchasers. More than 1,000 new mine records have been added in the last five years.

SOURCE: ANON, 2009, The hole story. *Ground Engineering*, May 2009, page 27.

The Allihies Copper Mine Museum and mining landscape, West Cork, Ireland

The Association for Industrial Archaeology's annual conference for 2011 was held at the University at Cork in the Republic of Ireland. Field visits included an operating distillery, historic transport infrastructure, and the Allihies mining museum and landscape.

Allihies is in the far southwestern part of Ireland, beyond Bantry Bay and Berehaven. It is a scenically very attractive area, and the tiny settlement at Allihies was essentially the result of Cornish miners arriving there to mine copper ores. The day we visited was reckoned to be one of the best the village had known for some years; we had all been warned to take warm clothing and serious rain-proofing, and in the event enjoyed glorious sunny weather and blue skies. The hillside is littered with nineteenth-century engine-houses and other mining-related structures, and shafts, all very explorable, although access underground is restricted (and to a large extent impossible as most of the mine is below sea level and now flooded).

There is also an admirable copper-mining museum, art gallery, and rather good café established in a former Methodist church which was built in 1845 for the miners. Copper was found and worked here in the Bronze Age, although modern industrial scale mining at Allihies dates only from 1812. The museum is open daily, from June to September; and additionally at weekends in April, May and October, and during Easter.

DETAILS: Allihies Copper Mine Museum, Beara, Co. Cork, Ireland. Tel: 00353(0) 27 73218 / Email info@acmm.ie / website www.acmm.ie.

NEWS – MISCELLANEOUS

Traffic lights for bats in an Oxford railway tunnel

A special breed of 'commuters' are to get their own traffic-light safety scheme to warn them about trains – bats.

The new light system has been installed for the first time in the UK in a city railway tunnel to make sure bats get a warning about trains rumbling through. The trial at Wolvercote tunnel in Oxford was commissioned by Chiltern Railways as part of its plan to create a second Oxford to London Rail link, via Bicester.

If the plan is approved, the number of trains running through the tunnel, which takes the line under Wolvercote roundabout on the A40, will increase; they will also run a lot more quickly. The idea of the trials last August was to see whether triggering lights inside the tunnel when a train is on the way will alert the bats and encourage them to move. The bats currently use the tunnel on their travels around North Oxford and Wolvercote, and as a temporary roost.

Ecological consultant Geoff Billington, who was in charge of the trials, said: "The greater proportion of the bats are light-sensitive and actively avoid lit areas. The basic idea of the system is that the lights will come on and then a train appears. We hope that the bats may learn to associate the two things. It is clear they already scamper out of the way when we have observed them as trains pass through the tunnel now."

Natural England wants to make sure bats will not be disturbed by the extra trains. While there have been a number of studies about interaction between bats and roads, there is almost none on how they react to trains.

SOURCE: *Oxford Mail*, 15 August 2011.

New art galleries in old oil tanks at Tate Modern, London

Former oil storage tanks at what was once the Bankside Power Station (now Tate Modern) are to be converted into art galleries. The tanks are reportedly each thirty metres wide and seven metres high.

SOURCE: ANON, 2011, Bankside oil tanks to reopen as galleries. *Greater London Industrial Archaeology Society Newsletter* 255, page 9.

The South Eastern Industrial Archaeology Conference (SERIAC) – next Conference at Newbury, Berkshire, Saturday 28 April 2012

Paul W. SOWAN

I represent Subterranea Britannica on the organising committee for SERIAC, the South-Eastern Industrial Archaeology Conferences. SERIAC has no formal existence, but is an informal liaison between IA societies in Berkshire, Hampshire & Isle of Wight, Kent, London, Surrey and Sussex. Subterranea Britannica is, evidently, regarded as another (subterranean) county!

Each county society, taking turns, arranges an annual regional day conference, which generally attracts 100 to 250 or more attendees. Subterranea Britannica has not been asked to take a turn in organising conferences!

The 2012 conference is to be organised at Newbury by the Berkshire IA Society on Saturday 28 April 2012. A post-conference (late afternoon / early evening) visit to Greenham Common is planned.

In default of a county-wide IA society in Kent, there has been no conference in Kent since one at Cranbrook some years ago. The Kent Archaeological Society has now established an Industrial Archaeology Committee, with Mike Clinch (former Secretary of the Kent Underground

Research Group) as secretary. Mike attended the SERIAC Committee meeting at Redhill on Sunday 26 July 2011, and hopes to be able to arrange a SERIAC conference based at Chatham Dockyard in 2013.

Restored cemetery crypt, coffin winch, rail tracks and other crematorium fixtures and fittings, Bristol

A Victorian cemetery in Bristol has been reopened to the public after a £5m restoration. Visitors are able to visit an 'unique underground space' below a listed chapel at the Arnos Vale Cemetery. There is a winch for lowering coffins, and recycled rail track for their conveyance to a cremation furnace dating from 1928. The public were last admitted to view this site in 1929, as a public relation exercise for one of Britain's earlier crematoria.

SOURCE: KENNEDY, Maev, 2010, Restored crypt offers day out with a difference. *The Guardian*, 29 April 2010, page 14.

Hibernating bat records, winter 2010 / 2011, for Surrey

In Surrey, very commendably, the Wealden Cave and Mine Society collaborates with the Surrey Bat group in the interests of bat conservation and recording. The winter of 2010 / 2011 having been unusually severe, higher numbers of hibernating bats have been recorded. And a very rare species, not recorded in the county for many years, has been recorded – a barbastelle bat at Albury.

Six species of bats altogether have been found hibernating in (more or less) underground sites in Surrey this last winter, at 13 sites. The species recorded were Natterer's, Daubenton's, Brandt / Whiskered, Brown long-eared, Barbastelle, and Pipistrelle bats. Pipistrelles do not normally hibernate underground – but perhaps the three recorded this year were driven underground by the cold! The sites include several hearthstone mines at Godstone, an underground chalk quarry at Westhumble, old lime kilns at Betchworth and Brockham, an 1890s 'fort' at Box Hill, and miscellaneous garden features (grottos, an ice-house, etc) at Albury, Busbridge, Clandon and Hatchford.

SOURCE: SURREY BAT GROUP, 2011, 2010 / 2011 hibernation season. *The Bat Detector* 60, 2 – 3.

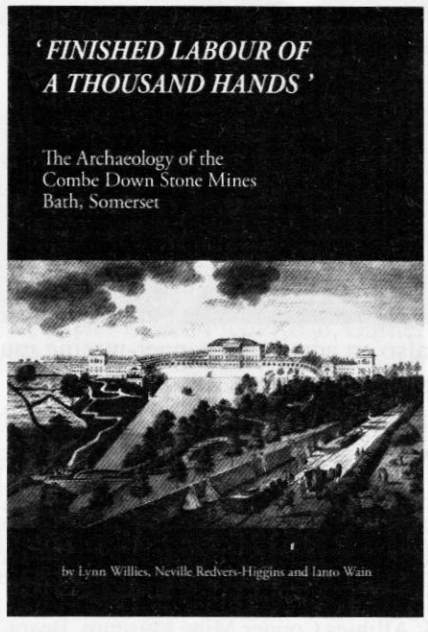
NEWS – PUBLICATIONS – BOOKS

Archaeology of the underground Bath stone quarries at Combe Down, Bath, Somerset

DETAILS: WILLIES, Lynn, Neville REDVERS-HIGGINS, and Ian WAIN, 2011, 'Finished labour of a thousand hands': the archaeology of the Combe Down stone mines, Bath, Somerset. *Oxford Archaeology Monograph* 13: xxi + 341pp [ISBN 978-0-904220-60-5] [£ 55.95 including postage and packing from Oxbow Books, 10 Hythe Bridge Street, OXFORD OX1 2EW / Email oxbow@oxbowbooks.com]

Until well into the 20th century the huge area of underground stone quarries below Combe Down (at the top of the hill a couple of kilometres to the south of Bath) was open to all comers. Subterranea Britannica argued the case for the archaeological value of the system, and indeed the writer (PWS) made at least one official visit underground with City officials, and entered into correspondence with English Heritage. Combe Down's Bath stone quarries are around a century earlier than the better–known Box and Corsham quarries. It is good to see that officialdom has at last agreed with our point of view, and indeed funded a major archaeological recording project!

Combe Down, now a civic conservation area, is covered in desirable houses, and crossed by roads some of which carry heavy traffic. With only a metre or so of very fractured rock between the ground surface and the quarry tunnel ceilings, realisation dawned that a major failure and subsidence could be expected sooner or later. Indeed, some smaller-scale subsidences have occurred, resulting in cracked walls and so forth. All access to the underground was blocked and barred on health and safety grounds, and for some years there was much debate about what to do, and how to pay for it. It was generally recognised that the quarries, the source of the finest 18th century buildings in Bath, were exceptionally important archaeologically and historically; an accident waiting to happen; and an important bat hibernation site.


'FINISHED LABOUR OF A THOUSAND HANDS'
The Archaeology of the Combe Down Stone Mines Bath, Somerset
by Lynn Willies, Neville Redvers-Higgins and Ianto Wain

The outcome has been the almost complete filling of all detected voids with foamed concrete, with a few token safe areas kept for the benefit of over-wintering bats. From 2000 to 2008 Oxford Archaeology was commissioned to monitor the filling process, and record and interpret the archaeology. Lynne Willies and his co-workers have achieved splendid results, even though they were not allowed to go anywhere underground unless or until steel roofed roadways were installed (!). Therefore much of the archaeology had to be viewed, photographed, or laser scanned at a distance. Archaeological recording was supplemented by archival research, and the considerable assistance of David Pollard is very properly acknowledged.

Although earlier quarrying is known or suspected, the Combe Down complex essentially is the work of Ralph Allen [1693 - 1764] who brought advanced management and working techniques to the exploitation of this resource from around 1730 until the time of his death, The published report claims that at 18 hectares (180,000 square metres) these quarries are the earliest large-scale underground quarry complex in England. That claim is debatable, as the very extensive underground building-stone (Reigate stone) quarries in east Surrey are certainly in large part older than Combe Down, and in total more extensive as well. However, the claim that the Combe Down quarries represent the biggest UK underground site to be surveyed by professional archaeologists cannot be challenged.

The published volume is impressive. The geology of the exploited limestone is explained, as is the joint pattern which dictated quarry layout and quarrying methods. Tools and working techniques, lighting, and Ralph Allen's use of early railways above and below ground are all addressed. Mapping and analysis of underground roadways and barrow-ways, and of spoil tips and other evidence has allowed quarrying directions and boundaries, and quarrying dating sequences to be deduced. The volume is handsomely provided with colour-printed plans, diagrams, and photographs. A minor fault is that end-paper maps referred to in the text have not in fact been provided. There are four pages of references, and a comprehensive index in a further five pages.

This work is essential reading for anybody seriously interested in underground archaeology in general, and underground stone quarrying in particular.

Much additional information will be found at www.combedownstoneminesproject.com .

Stiperstones mines, Shropshire

DETAILS: PEARCE, Adrian, 2010, *Field guide to Stiperstones mines*. Shropshire Mines Trust Ltd / Peter Burgess: 60pp [ISBN 978-0-9556081-5-5]

Barytes, calcite, lead, silver and zinc have all been mined in and around the Stiperstones area in Shropshire. This booklet offers brief details, including surviving surface remains, of the Snailbeach, Myttonsbeach, Perkinbeach, Burgam, Tankerville, Pennerley, Bog, Ladywell, Grit, Roman Gravels, and Wood mines. At some, access underground is possible in liaison with the Shropshire Mines Trust and / or Shropshire Caving and Mining Club.

Oil shale mines and the shale oil industry in the Lothians, Scotland

DETAILS: HUTTON, Guthrie, 2010, *Shale oil: a history of the industry in the Lothians*. Stenlake Publishing Ltd: 57pp [ISBN 978-1-84033502-6]

Oil shale was mined and processed at a number of places in West Lothian, west of Edinburgh, from the mid-19th to the mid-20th century. The shale does not contain oil, but an organic 'mineral' called keragen. When subjected to destructive distillation, this yields paraffin and other hydrocarbons.

Only small sections of one or two of the mines have been accessible in recent years, and, and most of the industrial plant demolished. The burned shale accumulated in huge bright orange spoil tips, called bings locally. These conspicuous features of the landscape, once considered eyesores, are often now regarded more fondly as a striking memorial to an important industry that lasted more or less exactly for a century.

Guthrie Hutton's booklet is essentially a pictorial history. It presents images of long-lost mines (a few underground photographs are included), retorts, and associated workers' housing and villages.

Slate quarries and railways at Corris Uchaf, Merionethshire

DETAILS: EADE, Sara, 2011, *Within these hills: a study of Corris Uchaf – Braichgoch Quarry, the Upper Corris Tramway and the social life of a Merionethshire village*. Author: 209pp [ISBN 978-0-9565652-1-1] [£25]

The Corris railway connected with the Welshpool to Aberystwyth main line at Machynlleth. This admirably produced book has a clear focus on the railway, but (unlike some railway histories) provides also a wealth of detail concerning the slate quarries (some of them underground), the quarrymen, and the social setting.

The volume is profusely illustrated, largely in colour, with underground views in the quarries, facsimile reprints of historic quarry and railway plans, large-scale Ordnance Survey plan extracts, photographs of surface buildings, etc. There is also much statistical and historical data, and a list of sources. Very much more than just a coffee-table book!

Ross Island and the mining heritage of Killarney

DETAILS: O'BRIEN, William, 2000, *Ross Island and the mining heritage of Killarney*, Galway: National Museum of Ireland Department of Archaeology: 30pp [ISBN 0-9535620-1-X]

This attractive little booklet describes Ross Island and the Lakes of Killarney, near the junction of Devonian sandstones and Carboniferous limestone, and associated archaeological evidence for copper mining in the Bronze Age, and later periods including the eighteenth century.

Another superficial book on sub-surface London

DETAILS: ACKROYD, Peter, 2011, *London Under*. London: Chatto & Windus: 202pp [ISBN 978-0-701-16991-6 (hbk)] [12.99]

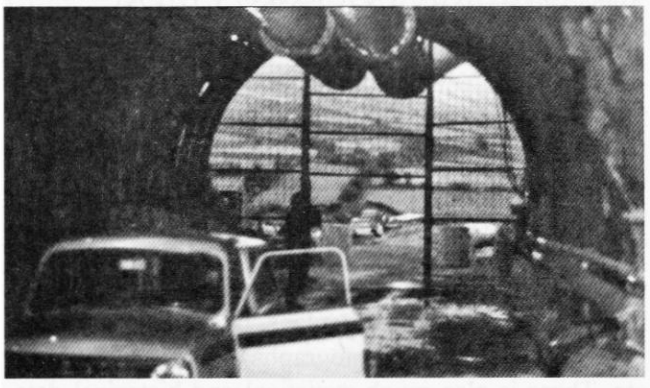
Peter Ackroyd has some thirty or so published books to his credit, so evidently sells well. However, this decidedly superficial account of underground London, noticing in passing anything and everything from buried archaeological remains to twentieth-century engineering works, will tell few Subterranea Britannica members much they don't already know, at least insofar as underground voids are concerned. The few small illustrations, also, are disappointing. [Paul W. SOWAN]

NEWS – TUNNELS AND MISCELLANEOUS

Underground tunnel rediscovered under Camlough mountain, Co. Armagh, Northern Ireland

A one-kilometre-long unlined tunnel driven through solid rock, wide enough to drive an articulated lorry into, was recently rediscovered deep under Camlough mountain. It was excavated more than forty years ago and marked the beginning of a development that would have led to a man-made cavern housing a power station capable of generating more than 200 megawatts of electricity.

Had it been completed, it would have provided a pumped hydro storage scheme, a simple and effective way of storing energy. It's a system that is used across the world and would have led to greatly reduced electricity bills for consumers. Water from Camlough Lake would have fed a vertical shaft into a turbine below.



The project became a victim of the troubles in Northern Ireland when workmen were threatened; this was one of the factors that led to the project being abandoned. Local people also recall hearing of concerns over logistics such as the need to raise the water level in Camlough Lake, fears of flooding and compensation to landowners – all of which would have had a significant bearing on the overall cost.

A complete hydro electric power station was also manufactured, paid for and shipped to Northern Ireland ready to be installed. But eventually, after lying around for more than two decades, it was sold for scrap.

SOURCE: *Crossmaglen Examiner* 8 November 2011

Cross-border drug found in California

Police have discovered a major cross-border drug tunnel running from Mexico to California and seized more than 17 tons of marijuana.

The 370-metre tunnel links warehouses in an industrial park south of San Diego and in the Mexican border city of Tijuana.

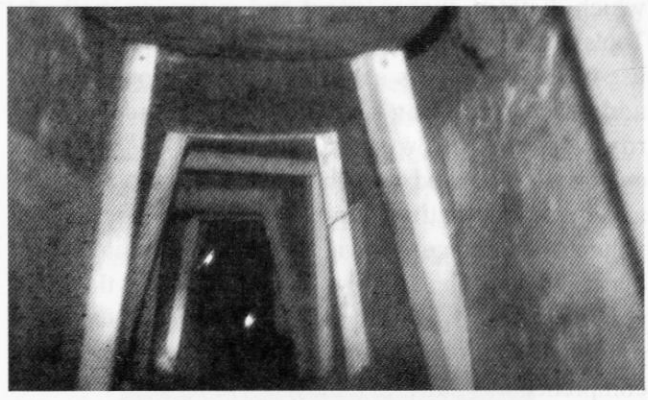
US federal agents made the discovery after police stopped a small cargo lorry seen leaving a warehouse near the Otay Mesa port of entry on Tuesday afternoon. A search of the building found the entrance to the tunnel in the floor. At the bottom of a 20ft shaft was a passageway measuring about 4ft by 3ft with structural supports, electricity and ventilation. Agents with the San Diego Tunnel Task Force retrieved three tons of marijuana from the lorry.

Another 6.5 tons of the drug was found in the warehouse and Mexican authorities discovered almost eight tons of marijuana on the south side. Evidence found inside the warehouse led investigators to believe the tunnel was only recently completed. Tijuana is the principal gateway for tons of drugs entering California from Mexico.

Last year, authorities uncovered two large tunnels linking the city with the strip flanking the border south of San Diego. Measuring around 2,000 metres in length, they were equipped with rail systems, lighting and ventilation and each discovery yielded multiple tons of marijuana.

Mexico is in the grip of brutal drug cartel violence that has claimed more than 42,000 lives since President Felipe Calderon took office five years ago and sent in the military to crush the powerful gangs.

SOURCE: Sky News 17 November 2011



The Frome Tunnel Project

Excited by persistent local stories of tunnels under Frome, but frustrated by the lack of access or real information, a group of 'tunnel myth' enthusiasts formed an investigatory team a few years ago to research, excavate and document the so-called 'Frome Tunnels'.

Through site investigations, historical document research, interviews and tip-offs, they are starting to assemble the missing pieces of the jigsaw of part of Frome's history from 300 years ago. At that point in time and earlier it seems that Frome was a significant town, occasionally engulfed by the tide of significant national historic events such as the Monmouth Rebellion (which started near Frome – Monmouth even built a house in Cork Street), the Reformation (the pendulum of Protestant–Roman Catholic religious persecution) and the Civil War (which was very uncivilised, by all accounts).

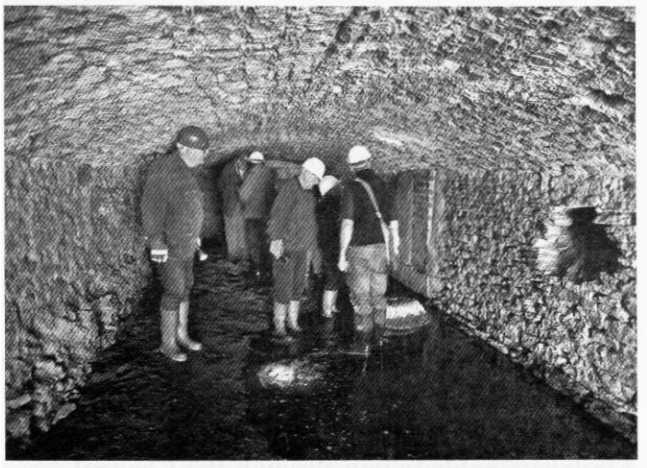
It would appear that tunnel myths date from this period – the reasons for their construction and detail of how many and where they ran are a carefully guarded secret and now lost over time, blocked or filled in.

Since being featured in the BBC1 *Inside Out* programme in 2006, many contributions from local people and frequent tours of the tunnels that have already been found in the Frome Festival, they now have a growing list of over forty sites to investigate and nearly 100 people have contributed locations, maps, or let us look around their buildings. They have over thirty first-hand accounts from

older residents of Frome who played in or explored some of the tunnels in their childhood.

This year the team have decided to schedule slots over two weekends to enable members of the public to volunteer to join in with the digging for a few hours. This is likely to be repeated next year.

SOURCE: Frome Tunnels Project website www.frometunnels.co.uk/index.html



Vault under the town bridge.

New subterranean site proposed at Royston, Hertfordshire

Royston Cave (the home of our founder Sylvia Beamon), in the centre of the town on the Hertfordshire / Cambridgeshire border, could be seen as the spiritual home of Subterranea Britannica. The medieval chalk 'cave' with elaborately carved walls, a Scheduled Ancient Monument, is now to be joined by a second subterranean site in the town: a new subway under the London to Cambridge railway lines at Royston Station. Doubtless any graffiti it may acquire will have less aesthetic and historic interest and appeal than that in the cave.

SOURCE; ANON, 2011, Birse to build subway at Royston. *Modern Railways* 68(751), page 16.

More Underground Stations Listed, London

The number of London Underground stations statutorily Listed as of historic or architectural importance has been added to.

The stations are Aldwych, Belsize Park, Brent Cross, Caledonian Road, Chalk Farm, Chesham, Covent Garden, Hendon Central, Oxford Circus (two original stations combined), Perivale, Redbridge, Russell Square, St John's Wood, West Acton, and Wood Green. Some of these, of course, are surface stations. Additionally, Arnos Grove, Oakwood and Sudbury Town stations have been promoted to Grade II*.

SOURCE: ANON, 2011, More tube stations given Grade II protection. *Greater London Industrial Archaeology Society Newsletter* 255, page 9.

Proposed new rail tunnel at Lewes, East Sussex

The traffic carrying capacity on the main line from London to Gatwick Airport and Brighton, although laid as four tracks at several points, is severely limited by there being only two tracks through each of the two long tunnels at Balcombe and Clayton (south of Hassocks). And when, as so often in modern times, the line is closed for engineering work, passengers are either decanted into buses, or sent by train the long way round via Horsham and Worthing.

Until widespread rail line closures there were excellent alternative routes via Oxted, East Grinstead and Lewes; or via Oxted, Uckfield and Lewes. The latter route has long since been stopped at a terminus at Uckfield, leaving a short gap of eight or nine miles where the line on to Lewes was closed.

The Wealden Line Campaign to reopen this link has been vigorously pursued for some years, and in political and economic terms is rated as one of the top priority rail re-openings. Now under the title BML2 (Brighton Main Line 2) the campaign is being pressed with renewed fervour, proposing a second rail tunnel under Lewes to allow trains via Oxted to run through to Brighton via Falmer without conflicting with existing London to Eastbourne services.

SOURCE: ANON, 2011, Uckfield trackbed threat raised in Lords. *Modern Railways* 68(758), page 7.

Former Rawsley & Buxton Railway tunnels now open to pedestrians, Derbyshire

Six disused tunnels on the former Rawsley & Buxton Railway in Derbyshire are now open to walkers. They are (in order from Rawsley):

Headstone tunnel	533 yards
Cressbrook tunnel	471 yards
Litton tunnel	515 yards
Chee Tor No. 1 tunnel	301 yards
Chee Tor No. 2 tunnel	94 yards
Rusher Cutting tunnel	121 yards

SOURCE: McCARTHY, Pat Justin, 2011, Peak District tunnels. *Bull. Railway and Canal Historical Society* 432, page 16.

Local passenger services through the Channel Tunnel as well as Eurostar

What seems an obvious gap in Kent and Pas-de-Calais railway timetables is a fast rail Channel Tunnel link between major towns either side. If you live in or around Dover, you have to take a train back inland to Ashford to catch a Eurostar (and pay the same fare as if you had started from London!). And if you live in Calais you are limited to a small number of Eurostar trains which pick up at Fréthune (just outside town) and take you on to Ashford.

Frequent and regular local services with intermediate stops between Lille, St Omer, Calais (Fréthune), Folkestone and Ashford seem an obvious missing link. After all, frequent well-patronised local trains buzz back and forth across national borders between France, Belgium, Luxembourg, the Netherlands and Germany, and have done since the railways were first built! It might happen. Currently, Eurotunnel is offering a 10 percent

reduction on Channel Tunnel access charges to any operator willing to introduce such a service.

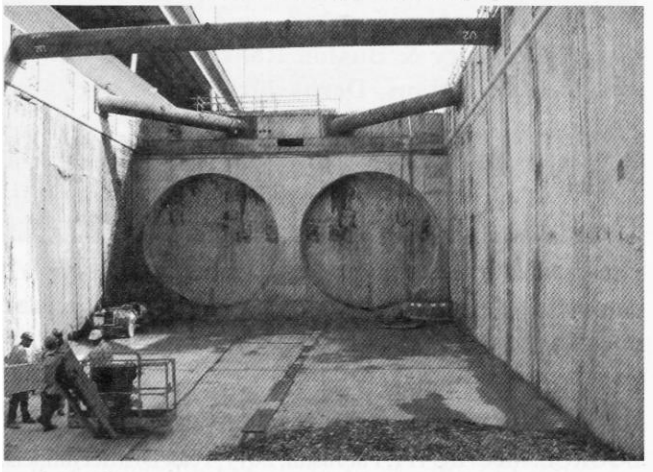
SOURCE: ANON, 2011, Kent – Pas de Calais service mooted. *Modern Railways* 68(758), page 82.

Crossrail's Royal Oak portal completed, London

The first of eight tunnel-boring machines (TBMs), manufactured in Germany, will commence boring tunnels for Crossrail at Royal Oak, west of Paddington Station, in the Spring of 2012. This is where eastbound Crossrail trains will go subsurface to travel astonishingly quickly (compared with buses, cars, taxis or tube trains) across central London – with several conveniently placed stops at sub-surface city-centre stations on the way.

The point at which tunnelling will commence has now been completed, within budget and 20 days early. A 285-metre access incline now descends a vertical-walled cutting to a concrete headwall kitted out with a pair of 7.24-metre-diameter tunnel portal 'eyes' where the TBMs will break through to commence their drives.

SOURCE: HARVEY, Dan, 2011, Crossrail update: Royal Oak Portal complete. *Modern Railways* 68(758), page 98.



Proposed HS2 High Speed Rail Line, London to Birmingham

Around eleven percent of the proposed High Speed railway line from London to Birmingham could be in tunnel, below parts of London and the Chiltern Hills, as an environmental protection measure. The tunnels under London would be 30 to 50 metres below ground. Under the Chiltern Hills the line is expected to be at shallower depth.

SOURCE: ANON, 2011, Tunnels on HS2. *Modern Railways* 68(751), page 71.

Tunnels and heritage railways

Railway closures predate the widespread and well-known closure campaign instigated by Dr Richard Beeching in the 1960s and, in recent decades, have been followed by significant reopenings of stations and lengths of abandoned line as restored parts of the national rail system. Alongside such reopenings, of course, there are also the 'heritage railways' reopened and operated primarily as tourist attractions.

The Heritage Railways Association lists around one hundred of these, and 35 railway museums and/or centres in the UK and Ireland. A number of these heritage lines feature tunnels taken back into railway use, or have ambitions to extend their metals through currently abandoned tunnels. The Severn Valley, the East Kent and the Ffestiniog preserved railways, for example, have their trains running through short tunnels.

In the south-east the Bluebell Railway (www.bluebell-railway.co.uk) has already extended its line northwards through the tunnel below Sharpthorne village in Sussex to its present terminus at Kingscote. Similarly, the Spa Valley Railway (www.spavalleyrailway.co.uk) would like to reopen the short stretch of their line from the Tunbridge Wells West station (now a pub) to Tunbridge Wells Central. Unfortunately, reopening this short link (through a tunnel) is hindered by Messrs Sainsburys' new store built across and in front of the west portal. But supermarkets come and go so another tunnel reopening here is quite possible in the medium or longer term.

SOURCE: ANON, 2011, Linking classic and heritage. *RailSE [Newsletter of Railwatch SE Region]* 112 (June 2011), 1 – 2 [Details for the Bluebell and Spa Valley heritage railways].

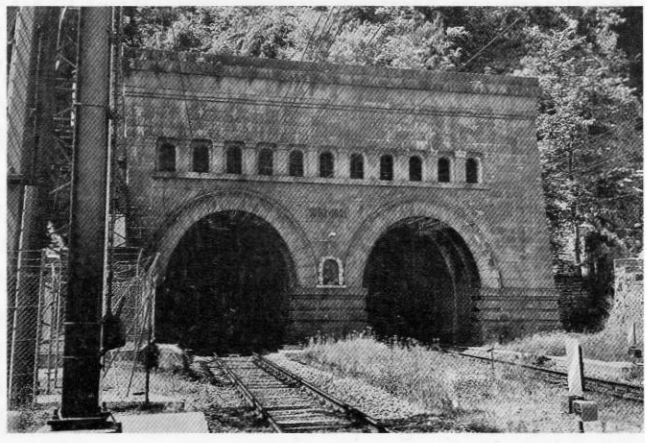
Electricity cable to run through the Channel Tunnel, England / France

An electrical power cable rated at 500MW is planned to run through the Channel Tunnel's service tunnel (between the two running tunnels). There are already under-sea cables linking England and France, and the new cable will increase cross-channel capacity by twenty percent. As the peak demand hours differ in England and France, it makes economic sense to transfer electrical power one way or the other depending on demand.

SOURCE: EUROTUNNEL, 2011, Eurotunnel plugs into power deal, *Evening Standard*, 26 May 2011, page 51.

Fire damage at the Simplon railway tunnel, Switzerland / Italy

The 19.823 km second Simplon tunnel, opened in 1921, links the Swiss and Italian railway networks through the Alps between Brig and Domodossola on the Bern – Milano route. It runs parallel to the first tunnel which was opened in 1906. The two single-track tunnels are interconnected about halfway through, just on the Italian side of the frontier.



A fire on a freight train in the southern bore, about three kilometres in from the south portal, severely damaged

the tunnel lining on 9 June 2011. Temperatures reached 800 C, and smoke travelling via the interconnection resulted in both tunnels being closed to traffic. Smoke escaping from ventilation shafts also resulted in the closure of the road over the Simplon Pass. Although the fire was on the Italian side of the border, Swiss railway authorities have responsibility for repairs to the damaged 300 metres of tunnel lining, expected to be completed by December 2011. Regional trains through the tunnels have been suspended, although now the smoke has cleared long-distance services continue through the older tunnel.

SOURCE: ANON, 2011, Simplon badly damaged by fire. *Modern Railways*, 68(757), page 81.

Copenhagen to have its own exclusively subsurface 'Circle Line', Denmark

In 2009 it was reported that construction of an underground railway 'circle line' for Copenhagen was expected to commence late in 2010. The Danish capital's existing metro lines, opened in 2002, connect the city centre to the airport and southern suburbs.

The new ring line will have interchange stations on the older line at two points, Frederiksberg and Kongens Nytorv stations. A branch off the southern part of the ring will connect to a control and maintenance centre with a small 'ring' track of its own. The entire 15 km line will be in tunnel at depths of from 20 to 35 metres, with spoil extraction from three shafts. Much of the ground is low-lying and waterlogged, and immense care will be called for during tunnelling under the historic city centre. The tunnels themselves will be driven mostly through underlying limestone. Four 5.7 metre diameter tunnel-boring machines will be used, although stations will be of cut-and-cover construction, built top-down, with platforms typically around 19 metres below ground level. It was estimated in 2009 that tunnelling could be completed in 30 to 36 months.

SOURCE: Jessica ROWSON, 2009, Rail special: Copenhagen Cityringen: gently does it .... *New Civil Engineer*, 5 November 2009, 26 - 27.

Supersewers at Milwaukee (USA) and London

London's intended deep-level sewer running, to a considerable extent, below the bed of the River Thames has attracted some opposition, largely on account of the proposed siting of tunnel spoil-extraction sites in public open spaces.

The 'antis' can now cite Milwaukee's experience with such a sewer in support of their arguments. The US city's sewer (which cost $1.2 billion) has reduced the volume of untreated sewage discharged to its main river by 85 percent. However, there have been complaints of flooded basements and sewage overflows.

In October 2011 proposals for a shorter London super-sewer were put as an alternative to the £3.6 billion Thames Water plan, which it was felt might save some districts from being blighted as construction sites for at least seven years. A report commissioned by Hammersmith & Fulham Council suggests a shorter and cheaper sewer.

SOURCES: DONINICZAK, Peter, 2011, Make Thames supersewer shorter, says new report. *Evening Standard*, 31 October 2011, page 8.

PRIGG, Mike, 2011, Supersewer? Think again, says US city that has one. *Evening Standard*, 3 August 2011, page 18.

Deepest immersed tube tunnel planned for South Korea

South Korea's Busan-Geoje highway was reported 75 percent completed in August 2009. The 8.3 km fixed link includes the world's deepest immersed tube tunnel, 3.2 km long and up to 48 metres below sea level and an important container shipping route. Other features are an additional one kilometre of bored tunnel, and pylon cable-stayed bridges. The link was expected to open to traffic late in 2010.

DETAILS: ANON, 2009, South Korea mega link nears completion. *New Civil Engineer*, 20 August 2009, page 6.

Coal Mines of Iceland

The Icelandic coal mines worked thin and poor quality seams of lignite formed from vegetation fossilised between lava flows, the main sites being in the northwestern fiords and on the Tjörnes peninsula in northeastern Iceland, as well as a handful for very small workings in the eastern fiords. A paper by Gu mundur Gu mundsson of Reykjavík in the *Yearbook of the Icelandic Archaeological Society*, based on surviving Icelandic primary sources, reviews the history and current state of these mines.

Iceland, or at least Reykjavík, relied heavily on coal for domestic heating before the development of the geothermal city hot water supply system after World War II. The city even had a coal gas works. Most of the Icelandic coal-mining dates from World War I, when there was a significant shortage of imported coal. Very similar coal mines in a similar geological context were worked on the island Su uroy in the Faeroe Islands from the 18th century.

The largest mine, at Ytri Tunga in Tjörnes, was state-owned. The author reports his investigation of a still-accessible mine in Dufansdalur in Arnarfjör ur, which is a single adit about 1.3m x 1.5m and 70 metres long. The paper includes a measured plan and cross-section of this mine, and photographs of the interior and of the tunnel entrance.

The report also contains an historic plan of the Tunga mine, a small network of mine galleries, and photographs of mine locations.

SOURCE: GU MUNDSSON, Gu mundur J., 2005, Hollur er heimafenginn baggi: Surtarbrandsnámur á Íslandi. *Árbók hins Íslenzka Fornleifafélags* 2004 – 2005, 51 – 84 [Summary in English on page 84]

Royal Air Force Bempton

by John Higton

From 1957 to 1959 I served as a National Service Radar Mechanic at RAF Bempton in East Yorkshire. Most of my working days were spent below ground in the bunker, or "hole" as it was known, maintaining the then very high-tech radar equipment.

It was an interesting place fulfilling an important defence function. Russian aircraft regularly made clandestine reconnaissance flights down the North Sea. Nuclear weapons were newly developed and spreading at an alarming rate and relations with the USSR continued to deteriorate; the Cold War had begun. Bempton's job was to give early warning of approaching aircraft and ships.

Over forty years later

I left Bempton in 1959 and apart from a brief visit in 1963 when I took two photographs (one reproduced here), I did not return until 2003. The intervening 44 years had not been kind to Bempton. The radar equipment was removed after 1964 and, although some secret research work was carried out later, when this finished the bunker was left to deteriorate and the site returned to agricultural use.

As at so many structures of this type, vandals soon broke in and trashed what they couldn't steal. Much of the air-conditioning ducting which was suspended from the roof and out of reach had survived, but the cable trays which were originally hung from the false floor were very badly damaged. Anything of value had gone and most other remains were totally smashed.

This experience revived many memories and inspired me to research Bempton's history but I soon found that very few official records have survived. This applies to the other R1 bunkers too and is probably due to the secret nature of their original function and their short operational life.

There are general arrangement drawings of the R1 bunker but no photographs – official or unofficial – of the interior. For Bempton there is one early very basic drawing of the surface layout and a set of Operational Records for the 1950–1961 period. It appeared that Bempton was in danger of being forgotten. Those with first-hand experience were getting old, memories were fading and some had already died.

Recording the site

I was determined to record the Bempton I remembered so the only option I had was to survey the remains at Bempton and other R1 sites to establish the dimensions of the basic bunker and record what remained of the plant and equipment. Fortunately some of the equipment, missing or damaged beyond repair at Bempton, was still intact at Portland and this proved a valuable source. The remaining air-conditioning ducting and equipment was largely intact and was recorded. Details of the radar equipment were gleaned from the RAF Air Publications – the maintenance manuals for the technical equipment; these contain many detailed photographs and drawings.

With the information from these sources and some personal memories I was able to build up a detailed picture of Bempton in its 1950s form. I now had a large amount of information and the question was, what should I do with all the data recovered?

A detailed model of the whole complex using computer graphics seemed a good way of presenting my research but I had no knowledge of this technology. I originate from the pre-computer era, but I was retired, had plenty of time and so learning something new was a challenge. It was a steep learning curve but eventually it all came together resulting in a very detailed 3D model of a fully-equipped Bempton.

This illustrated history and the DVD is the result of this work.

RAF Bempton 1940–1964

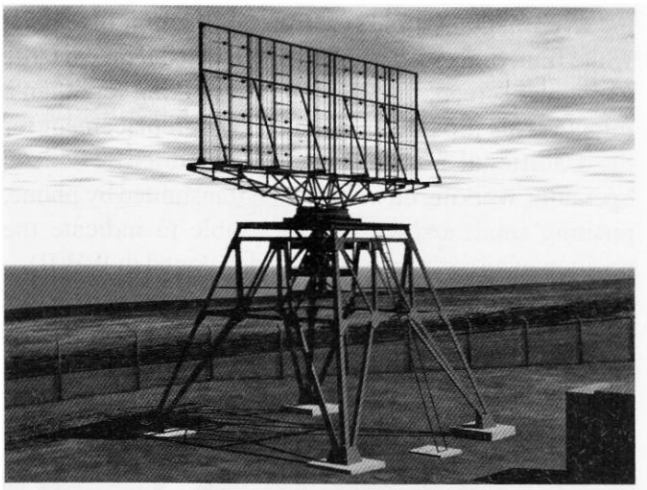
The remains of RAF Bempton stand on 350-foot-high cliffs a few miles north of Bridlington in East Yorkshire. From 1940 to 1945 RAF Bempton was one of a chain of radar stations around the coast. Radar at this time was in its infancy, initial development having begun only five years earlier.

World War II radars

The first radars around the coast of the UK were Chain Home (CH) Mk1 stations. (The term Chain Home originates from the "chain" of stations around the "home" coastline. There was also a Chain Overseas.) These CH stations consisted of two groups of masts – one for transmission and the other for reception. The transmitter group were 360-foot-high self-supporting steel masts with the transmitter aerial arrays suspended between them. There was a separate group of 240-foot wooden masts with three levels of dipole aerials for reception.

These radars operated at wavelengths of several metres. The radiation from CH radars was of the "floodlight" pattern, covering a wide area in front of the array. They were very effective at high level, having a range of up to 150 or even 180 miles, but hostile aircraft soon found they could avoid detection by flying at low altitude.

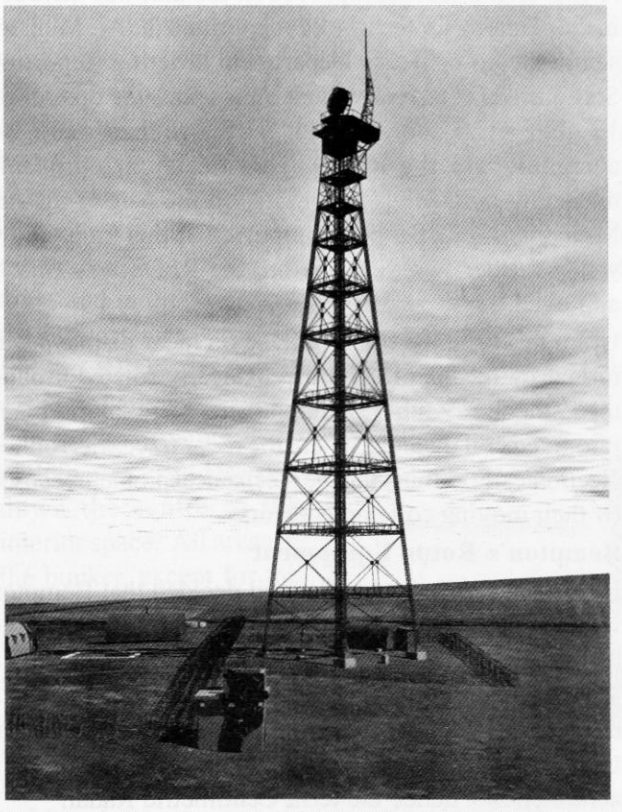
This low-altitude problem led to the development of Chain Home Low (CHL) radars which as the name suggests were designed to be lower-looking. They had aerials which could be rotated around the vertical axis – the early ones being turned manually by means of cranks somewhat like bicycle pedals. The first version did not rotate continuously as modern radars do but was turned to point at the target aircraft and the range was displayed on the radar screen with the direction in which the radar was currently pointing being noted and plotted onto a table to provide positional information.



The Chain Home Low (CHL) head. This was the second CHL head at Bempton it was a 1941 type head installed at the cliff edge site. The CHL head operated at 200 Mhz at a wave length of 1.5 metres. CHL achieved a range in excess of 100 miles and could detect aircraft at 25 miles range at a height of 500 feet

These aerials eventually allowed for Plan Position Indicator (PPI) displays on the radar screens – where the traces of aircraft were placed on the screen in their true geographical positions – effectively in plan form.

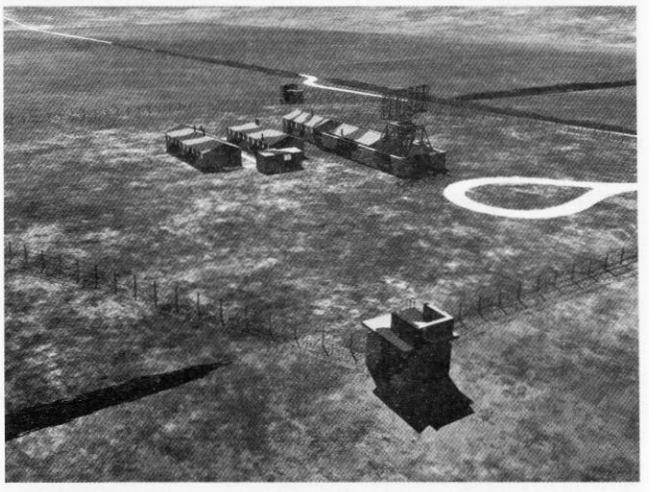
History repeated itself and soon it was found that aircraft were still undetected at under 50 feet. Once again the boffins came up with a solution, this time the Type 54 Chain Home Extra Low (CHEL) with rotating aerials mounted on 200-foot towers. This was effective in detecting shipping and ultra-low planes out to 25 miles.



The Chain Home Extra Low (CHEL) head. The CHEL head operated at 10 centimetres and employed the new British invention, the Magnetron

Bempton in World War II

The first radar station in this area was installed in early 1940 a few hundred feet from the lighthouse at Flamborough Head. This was a CHL and was at an elevation of only 130 feet; at this height performance proved to be very unsatisfactory. A new higher site was urgently needed and this was found four miles up the coast on the cliffs at Bempton.



July 1940. The buildings are a billet, the cookhouse, the rest room, store and sick quarters and the ops room with the CHL head. There are also two pill boxes, one of which doubled as the commanding officers quarters, on opposite corners of the diamond-shaped site

The site chosen was the 350-foot-high Standard Hill, a few hundred yards from the cliff edge. When RAF Bempton became operational in July 1940, radar coverage was much improved. In 1943 Bempton was equipped with a CHEL radar installed on the original site. In addition to the Standard Hill site a new site closer to the cliff edge was constructed with a new improved 1941 Type CHL radar head. This was Bempton's final major item of equipment added during the war.

WWII Living Accommodation

During World War II, on-site domestic accommodation was provided only for the army. RAF personnel lived off-site – the women were billeted at the Flamborough Hotel in the nearby village of Flamborough and the men in various private homes around Bempton. The pillbox next to the road on the Standard Hill site was used for the CO's quarters and from an aerial photo of the time there appears to be a vegetable plot next to the pillbox, probably an attempt to supplement wartime food rationing and shortages.

Beginning of the Cold War

At the end of World War II Bempton was disbanded and the site was allowed to deteriorate until the Berlin Blockade and threats from the USSR, who had recently exploded an atomic bomb, caused an urgent review of Britain's security. It was the official view that the UK was virtually defenceless against new, fast, high-flying aircraft. This led to the short-term plan to reopen wartime radar stations. Bempton reopened as a CHL/CHEL

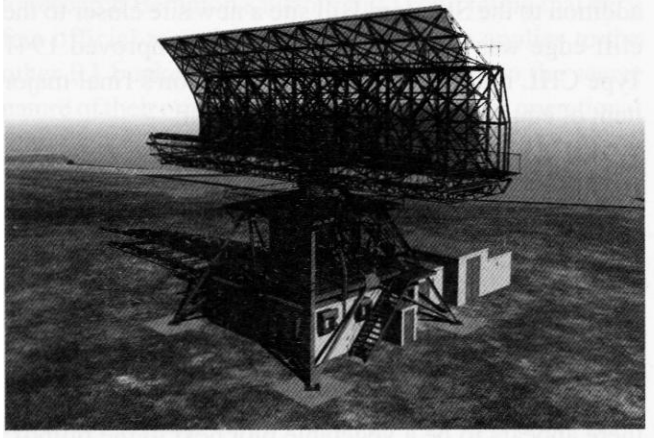
station in June 1949 – an inadequate stop-gap until the anticipated improved radars were developed as part of the Rotor plan.

Technical Developments and the Rotor Plan

The Rotor plan was an extensive and extremely costly radar defence initiative involved a new network of radar stations around the country, most of which were to be built underground. This plan was to be in two phases. In the first phase of the programme the new Rotor radar stations were to be equipped with upgraded and reconditioned World War II equipment (Stage 1 Radar). In parallel, research was initiated to develop new radars able to deal with the new, high-flying, high-speed, jet aircraft, to be ready by 1957 (Stage 2 Radar).

In early 1951 there was intense activity at the Telecommunications Research Establishment with a project code-named *Green Garlic* which involved improvements to radar equipment. One experiment with two Type 14 Mk 6 aerials fixed end to end, producing in effect an aerial 50 feet x 8 feet mounted on an existing Type 7 turning gear, produced a radar image with a big increase in range and definition. This became the Type 80.

However, the early introduction of the Green Garlic (Ames Type 80) radar in 1954 upset the programme, with the second stage becoming the introduction of Type 80 radar (technically called Stage 1A radar). The original Stage 2 radar became Stage 3 radar. These Stages should not be confused with the Rotor 1 *Phases* I, II, and III, which were entirely different.



The revolutionary Type 80 head. This head was a huge success - it was large, the aerial itself was 75 feet wide and 25 feet high, and was mounted on a gantry 33 feet high. It had very high definition and the range was an astounding 250 miles, almost three times the range of its British predecessor - the Type 14. The Type 80's improvement in performance immediately reduced the need for many of the new radar stations and led to the short service life of Bempton and several other CEW stations

In April 1949 the first experimental model of the Radar Photographic Display System (RPDS) was developed by Kelvin Hughes. This piece of equipment photographed the live image of a radar screen onto 35mm black and white film, processed it and then projected it onto a large horizontal screen, the whole process taking less than a minute. This provided a more efficient replacement for the traditional plotting procedure, which relied on operators, working on information transmitted by phone, pushing small arrows around a table to indicate the position of aircraft (as originally developed in WWII).

The RPDS well, which was the concrete box which hangs below the bunker, was known as "the udder". It contains two Photographic Display System projectors and attendant control cabinets. There is a small darkroom along the end wall used for loading the 35mm film into cassettes for use on the projectors and for storing and preparing the photo chemicals

A year later a second improved RPDS unit was included in the planning for the Rotor Program and the Air Ministry sent a memo to Works Department ordering Reporting Stations (R1s) to have a well built under the ops room, 12 feet x 20 feet and 11 feet 6 inches deep, to accommodate the RPDS. This decision represents unusually bold forward thinking on the part of the Air Ministry, the RPDS being unproven at this time, and it was a further two years before the RPDS was finally approved.

Up to this time the rotating trace on radar displays was turned by means of coils mechanically rotated around the cathode ray tube. Developments were taking place into fixed coil displays where the radar trace was rotated electronically eliminating the mechanical problems caused by their moving coil predecessors.

Bempton's Rotor Equipment

By August 1950 the Air Council decided that Bempton was to be an underground Centimetric Early Warning (CEW) station as part of the Rotor plan. During World War II Britain had invented the magnetron, this being a new device capable of working at high power and at very high frequency with wavelengths measured in centimetres – hence the term Centimetric Radar.

Bempton's target service date was 31 December 1952. It was to be equipped with improved World War II radars consisting of a single Type 14 radar with PPI type displays

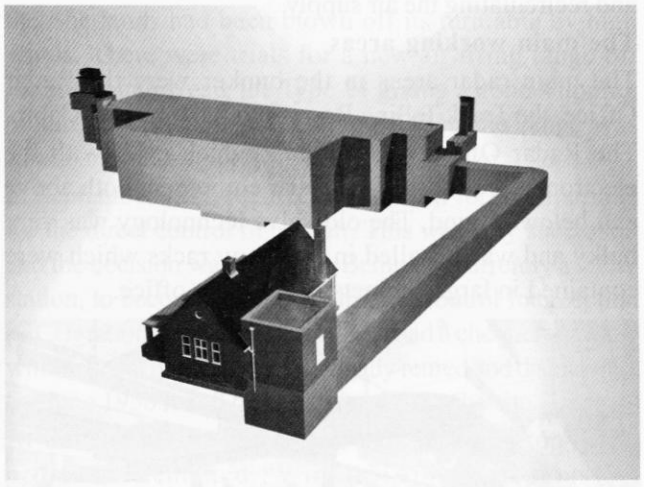
and three Type 13 nodding height finders. To supplement the Type 14 an imported American AN/FPS3 radar was to be installed to provide improved performance until the new British radars were ready.

The gantry-mounted Type 14. This was one of the improved Second World War designs. It was a development of the type 13 with a slightly larger aerial mounted horizontally, this radar produced the plan position indicator display with a rotating beam. The range of the Type 14 like the Type 13 was about 90 miles

In the second phase of Rotor, Bempton was re-equipped with the new (Stage 1A) Type 80 radar, the Type 64 fixed coil consoles and the RPDS unit. One Type 14 and the three Type 13s were to be retained at Bempton for Rotor 2.

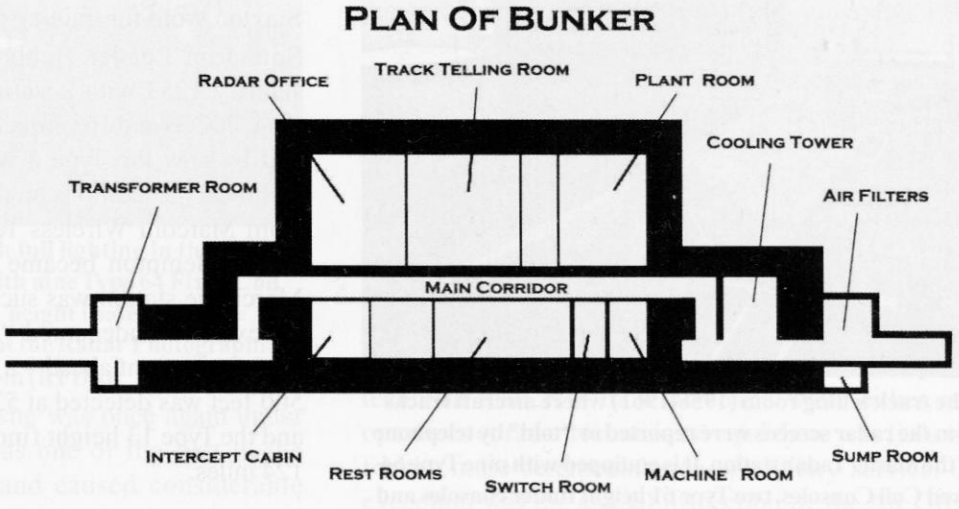
The Bunker

Construction of the bunker at Bempton began in 1951 and was completed by February 1953. The overall size of the bunker was 307 feet x 305 feet x 65 feet, the entrance tunnel adding an additional 300 feet. It was constructed in a 60-foot-deep excavation and covered by up to ten feet of earth. The entrance bungalow, the emergency exit and the two small ducts are all that can be seen on the surface. The main working space within the bunker was 98 feet long, 57 feet wide and 18 feet high, and in the floor was the 11 foot 6 inch deep well for the RPDS described earlier. There was a three-foot-thick stiffening wall, with five access doorways, down the centre of the interior space. All areas in the bunker, except for the Plant Room, were fitted with a false floor three feet six inches above the concrete base, supported by 6-inch-deep steel I-section beams from which cable trays were suspended. These trays were used for feeding the vast amount of cable between the radar heads on the surface, the Radar Office and the operational areas. The floor itself was made up of removable panels, to allow access to the underfloor cabling and other services. The floor panels were made of plywood – faced with teak in the main work areas and with linoleum in the corridors.



The hidden part of Bempton is the bunker: known by all who worked there as "the Hole" This massive structure is buried about 40 feet below the ground surface At the rear of the bungalow there is a building covering the stair well leading down to the top of the entrance tunnel. This 300 foot long tunnel provides the main access to the hole. The only other access point is the emergency exit which doubles as a cooling air intake. There is also a warm air duct and two smaller ducts used for foul air removal and a cable duct for connecting the aerial heads with the equipment in the hole

The 1950s valve-based equipment was made before solid-state electronics had been developed. There were thousands of thermionic valves – the glass tube type – all fitted with a small heater. These produced vast amounts of heat which had to be removed from what was effectively a large concrete box, with ten-foot-thick walls, floor and roof; all buried several feet below ground.



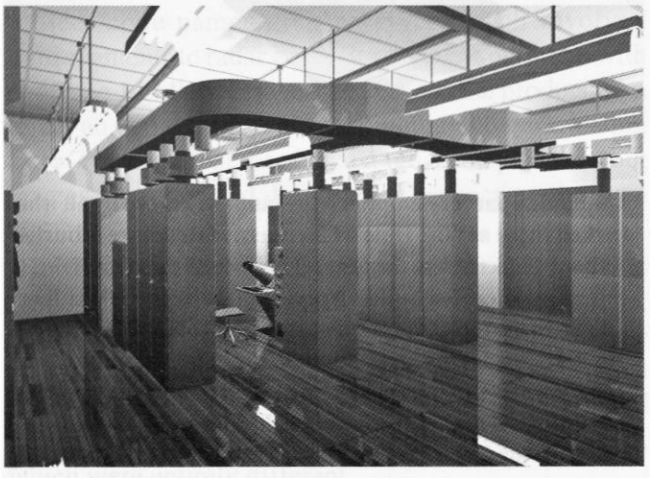
The layout of the R1 bunker at Bempton

The cooling and air-conditioning requirement involved an extensive air plant which was run by civilian workers from the Works Department. Air-conditioning was unusual in the 1950s; it produced a very pleasant working environment but it had another purpose – to allow the radar station to be sealed and continue to operate after nuclear attack (we hoped!), with the air plant cleaning and recirculating the air supply.

The main working areas

The main radar areas in the bunker were the Radar Office, the Track Telling Room and the Intercept Cabin.

The Radar Office was the area which dealt with the electronics for most of the radar equipment both above and below ground. The old valve technology was very bulky and was installed in the many racks which were contained in large cabinets in the radar office.



The Radar Office in 1955 - 1961. This is not an office in the normally accepted sense but the technical centre of the bunker from which the radar equipment is controlled. The racks are full of electronic units which control most of the circuitry for both the aerial heads and the radar display consoles. They contained hundreds of valves and electronic components. Cooling air is forced in at the bottom of the racks and exhausted through the overhead ducting

The track telling room (1956-1961) where aircraft tracks from the radar screens were reported or "told" by telephone to the master radar station. It is equipped with nine Type 64 Fixed Coil Consoles, two Type 61 height finder consoles and the 7 foot square screen of the Radar Photographic Display System (RPDS)

The Track Telling Room for early-warning purposes is the hub of the radar station where aircraft tracks from the radar screens were reported or "told" by telephone to the master radar station. In the first phase of Rotor the Track Telling Room was equipped with six Type 60 moving coil plan position-indicator consoles and three Type 61 height-finder consoles.

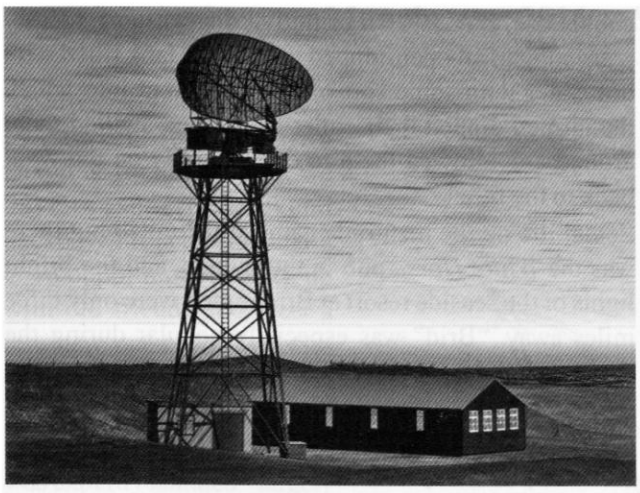
The Intercept Cabin was a smaller version of the Track Telling Room which as its name suggests was used for controlling the interception of hostile aircraft. The radar operators were in direct VHF communication with fighter aircraft guiding them to unknowns or 'hostiles'.

Bempton's main role was Early Warning but there was a single Intercept Cabin to provide some Ground Control Interception facilities. The picture is of the 1955-1961 Intercept Cabin equipped with two Type 60 Fixed Coil console and one Type 61 Height Finder consoles

Bempton's Cold War

On 27 August 1952 a Radar Supervisor, Flying Officer Draper, took command of RAF Bempton. The new bunker was still in the hands of Howards the contractors and the domestic site, being constructed by Shepherds, was almost complete. There was a senior NCO and 37 airmen who were living in the condemned hutted accommodation on the old CHEL site. The CHL Radar Type 2 on the cliff-edge site was still being used by RAF Staxton Wold for training purposes.

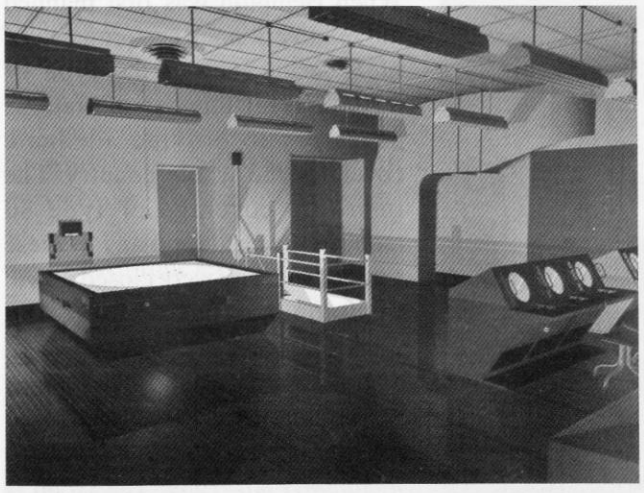
Squadron Leader Hebbourn assumed command in January 1953 with a station strength of nine Officers, nine SNCOs and 163 airmen. The Type 54 was dismantled and by now the Type 2 was inactive. In February the technical installations on the Rotor site were taken over from Marconi Wireless Telegraph Company and on 2 March Bempton became operational. As early as 19 March the station was successfully participating in the air exercise codenamed "Jigsaw". Testing of the new equipment went ahead – a flight by a Gloster Meteor at 500 feet was detected at 53 miles by the Type 14 Mk 9, and the Type 13 height finders were achieving ranges of 124 miles.



The AN-FPS 3. In late 1952 whilst the Type 80 development went ahead, as a temporary measure an American AN-FPS3 aerial mounted on a 50-foot tower was installed. The FPS 3 gave the station an improved range of about 200 miles

By the middle of 1953 the American AN/FPS3 head was installed and operational and in trials achieved ranges of 160–210 miles on Canberra aircraft flying at 40,000 feet. The performance of all the radar equipment continued to improve over the next year.

In August 1954 the CEW radar equipment was handed back to Marconi for stripping prior to the bunker being refurbished to Rotor 1A standards with the installation of the Type 80 and the new Type 64 fixed-coil consoles. Work continued on the upgrade and by early 1955 the installation of the new equipment was well under way. In May Kelvin Hughes started installation of the RPDS projectors with its seven-foot-square table in the Track Telling Room and the Type 80 was undergoing tests.



The Track Telling Room with full lighting in the 1956-1961 period. It is equipped with nine Type 64 Fixed Coil Consoles and two Type 61 height finder consoles and the 7 foot square screen of the Radar Photographic Display System (RPDS)

On 20 September 1955 the site was once again under RAF control. The RPDS was one of the first in the country to be operational and caused considerable interest, with many visitors coming to view its operational trials. The new equipment settled down well. The Type 80 was performing exceptionally; its range was well in excess of 250 nautical miles and providing very good definition allowing much better separation of individual aircraft on the radar screen.

On 8 January 1956, when 80+ mph winds were experienced, the Type 80 had to be taken off the air This was a sensible precaution as a Type 80 at Saxa Vord in the Shetlands had been blown off its turntable by high winds. There were trials for a new air firing range off Flamborough Head, the Type 14 giving a good shipping picture at up to 30 miles range. When the range was established Bempton provided Radar cover.

In September 1956 the RPDS was used for the first time for the direct control of aircraft. This was very successful and the decision was made for Bempton, currently a CEW station, to become a satellite Ground Control Interception (GCI) station. The AN/FPS3, which had a chequered career with frequent breakdown, was finally retired and dismantled. By June 1958 it had been removed from the site.

At the end of 1958 Bempton took part in a top-secret project codenamed "Winkle"; this was a passive detection system which enabled hostile aircraft to be detected even when they were jamming our radar. It was very complex system involving analysis of the jamming frequency by two widely separated radar scanners. Bempton's Type 80 was modified by Marconi to provide one of these scanners for the trials in conjunction with the Type 80 at RAF Bard Hill. This involved the Intercept Cabin feeding the Bempton T80 signal to RAF Bard Hill via a microwave transmitter on a mast adjacent to the Guardroom.

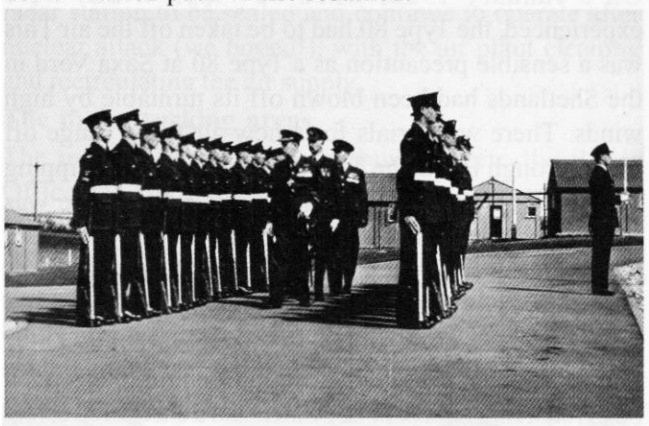
Life at Bempton during the Cold War

The Rotor site did not have living accommodation – this was provided at the domestic site, on Cliff Lane in Bempton village, about a mile away. This was a fully equipped RAF camp with a Guard Room, Headquarters Building, Sick Bay, Motor Transport section, Officers' Mess, Sergeants' Mess, NAAFI and cookhouse for the airmen, and pre-cast concrete hutted accommodation for the personnel. The billets were approximately 50 feet long and 20 feet wide. There were various other sections for the maintenance and works departments, a standby generator house and a boiler house for the central heating.

Most of the airmen – there were no airwomen – at Bempton were National Service men. At this time all UK males, at the age of 18, were liable to two years' service in the armed forces unless they were in full-time education or serving an apprenticeship in which case they were "deferred" until they had completed their training.

Bempton was a small unit concerned mainly with technical matters – most personnel were either radar operators or radar technicians – and there was little time for the more ceremonial side of military service. One exception was the annual inspection by the Air Officer Commanding (AOC). This meant a few weeks of

preparation involving rehearsing some of the drills learned at the early stage of RAF service, during the "square bashing" phase. Uniforms which tended to be neglected also had to be tidied up. But it was soon over and the usual relaxed pace of life resumed.



AOC's inspection in June 1956

The technical site worked a shift system which was operational for 24 hours a day. Travel between "Top Site" and the domestic camp at the change-over of shifts was usually made in the back of a three-ton truck with a canvas top. Outside these times, those without their own transport had a long walk in all weathers.

Catering for the masses

The 1950s were well before the days of "Health and Safety" as is demonstrated by one bizarre feature of the catering set-up. In those days each airman was issued with his own personal set of "eating irons" – knife, fork and spoon – and a one-pint china mug, which accompanied him throughout his service life. After meals at the cookhouse, there was a primitive dishwashing facility consisting of an open-topped galvanised tank filled with hot water with some sort of frothing agent into which the airmen dipped their cutlery and mug, swilled them around and allowed them to dry naturally on the walk back to the billet.

Social life on the men-only camp was limited but there was the *White Horse* pub in the village, and the bright lights of the seaside resort at Bridlington were only three miles away. "Brid" was especially popular during the summer holiday season. Sadly this has all gone – the domestic site, with a few of the original buildings converted to new uses, is now a holiday chalet park (some say it always was!).

Beginning of the end

In May 1959 Bempton briefly took over the Master Radar Station (MRS) role when the usual MRS, RAF Patrington, was off the air for maintenance. This led to the upgrading of Bempton to full MRS status.

It was planned for Patrington to undergo major re-equipment, which involved it being off the air for several months in 1961. During this time Bempton, in its new Master Radar Station role, took over MRS duties from Patrington with many personnel transferred for the period. By October Patrington had completed its re-equipment programme and resumed its MRS role.

Immediately after this the run-down of Bempton started, most of the personnel being posted out and on 1 December the station was disbanded and put on a care and maintenance basis. This was mainly due to the vastly improved performance of the Type 80.

This photo was taken in 1963. Bempton had already been disbanded but most of the technical equipment was still in place. It shows the Bungalow/Guard room with the box-like structure at the rear covering the top of the entrance tunnel leading to the bunker. The emergency exit and air inlet are just visible between the Type 13 nodding height finder and Type 14 plan position aerial heads. The low structures on the extreme left are the kennels for the guard dogs. Photo John Higton.

When Bempton was first planned the relatively poor performance of radar heads such as the Type 14 made a great number of stations necessary to provide adequate cover for the whole country. The improved coverage of Type 80 reduced the need for many of these stations so many were closed down. Bempton was one of these and finally closed in 1964.

The computer-generated images illustrating this article are taken from the animated *History of RAF Bempton 1940–1964*. The video is in colour and approximately thirty minutes long. It is available on DVD at £7.50 plus 60p postage. £6.00 from each sale will be donated to the RAF Air Defence Radar Museum at Neatishead in recognition of their invaluable assistance with my research.

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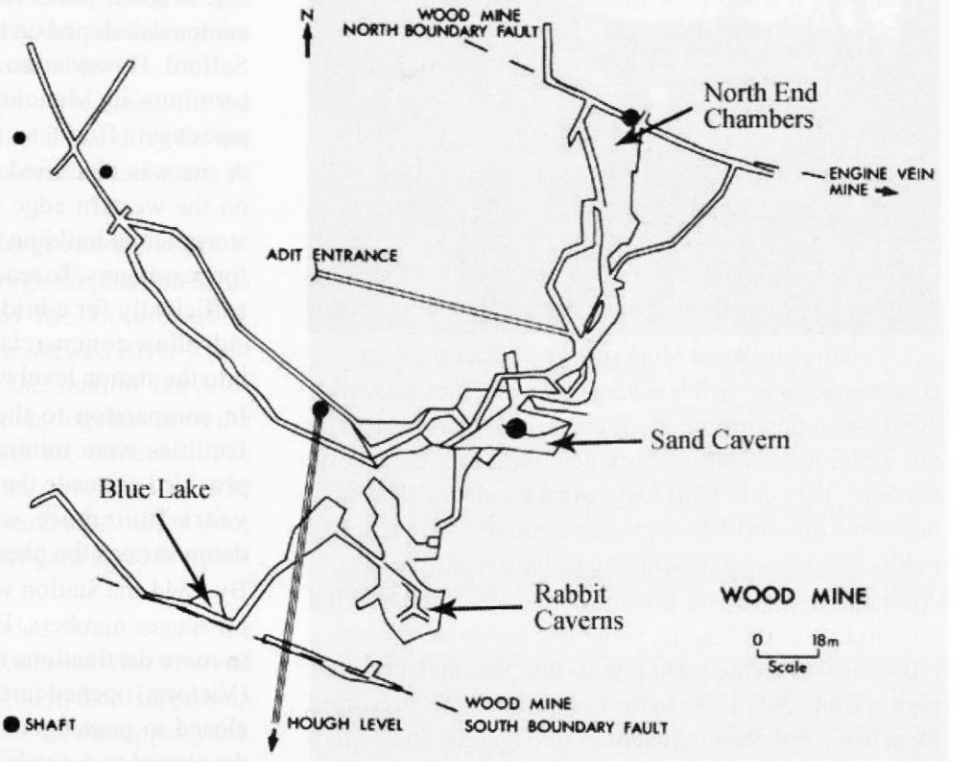
Manchester 2011 – Sub Brit's UK weekend

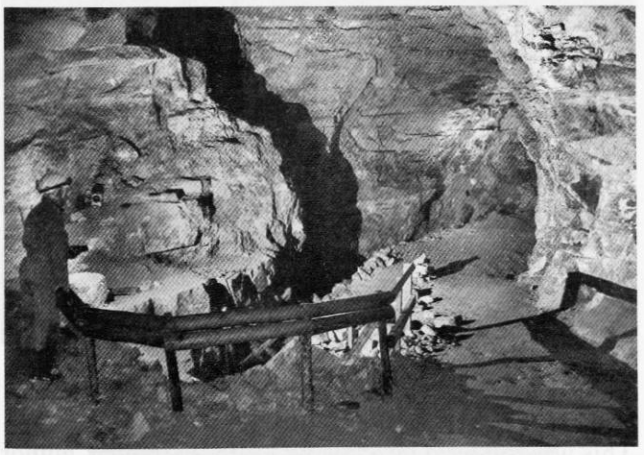
By Richard West

As always, when organised by MarLin Tours (Martin Dixon & Linda Bartlett), we have a superb weekend packed with activities and a good opportunity to catch up with old friends and meet a few new ones. The logistics of getting a large group (49 people) organised and all in the right place at the right time was expertly handled - largely by Linda, and excellent information packs were provided - largely by Martin. This is my recollection of the weekend with historical notes by Martin Dixon, Nick Catford, The Legends of Alderley Edge (web site), Paul Wright, Keith Warrender, Kathryn Sather & Associates and Wikipedia.



Friday 2 September – Alderley Edge Copper Mines

Mining has been carried out on the Edge since Roman times, as evidenced in 1995 when a fourth-century Roman coin was discovered hidden in an abandoned shaft in Engine Vein. Wood Mine was excavated during 1860–77 by the Alderley Edge Mining Company and is located in Windmill Wood. The mine worked the Wood Mine Conglomerates chiefly for copper but also for lead and cobalt in smaller quantities. Two WNW-ESE trending faults mark the extent of the mine to the north and south and are named the North Boundary (an extension of the Engine Vein Fault) and South Boundary Faults respectively. The rock in between these two faults has suffered minor faulting which resulted in the mine taking the form of four levels.



The sand cavern. Photo from Derbyshire Caving Club

The Wood Mine Conglomerates are impregnated with malachite, galena and cerussite with copper being redeposited in its secondary form. The mine was lit using candles with miners blasting the ore before digging it out using picks and shovels. Wooden tubs were used to transport the ore around the mine and it was then taken up a haulage level to the surface. The ore from Wood mine was transported to the West Mine treatment material.

In 1877 Wood Mine was closed when the Alderley Edge Mining Company went into liquidation. The mine was worked on a small scale during 1911–14 before it was abandoned. The entrances remained open which attracted irresponsible explorers and there were several accidents as a result. In 1964 Wood mine was sealed but six years later, the Derbyshire Caving Club (DCC) was given permission by the National Trust, which owns the land, to reopen the mine, which is accessed today via a level at the end of the old tramway.

Sub Brit visit

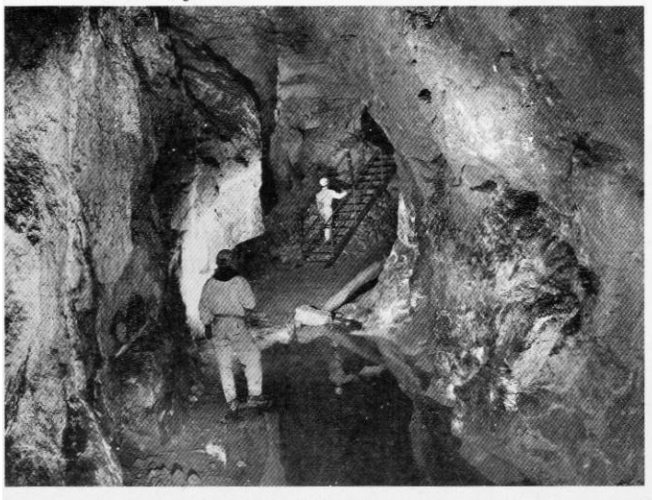
For a few of us who came up early, the weekend started with a pub lunch in Alderley Edge. The official weekend kicked off with a visit to Wood mine hosted by the Derbyshire Caving Club and led by Paul Stubbs. Three tours were organised to cope with the numbers (the National Trust, as landowners, limits parties to a maximum of of 14) each planned to last an hour and a half.

We entered by the reconstructed main entrance, having walked past the shaft entrance dug by DCC and now used as an emergency exit. The mine was in excellent

Entering the Wood Mine adit. Photo Richard West

condition with ore visible in some colourful runs, providing great photo opportunities – a great scramble was had by all. There were a lot of shiny new hard hats evident on my tour – they didn't last long in that condition! The mine had some low ceilings to crouch through which resulted in lots of banging and scraping of hard hats.

After the tour we had a wander over the Edge to find the entrance to the Engine Vein mine and to see the sights – then it was a quick change in the National Trust car park and an hour's drive to the *Campanile* hotel in Salford for a two- or three-night stay. Name badges and superb information packs were collected (lots to read later), then we were on our own for the evening and after a bit of exploring managed to get a curry and or two in the centre of Manchester, just over the river from the hotel.



North End chamber. Photo John Kyle

Saturday 3 September

After a hearty breakfast in the hotel (although with the amount of meat in the sausages they could probably have been eaten by vegetarians), it was a short walk, in an ever-lengthening crocodile, to the Museum of Science and Industry (MOSI).

Liverpool Road station and MOSI

Manchester Liverpool Road was the eastern passenger terminus of George Stephenson's Liverpool and Manchester Railway which opened on 15 September 1830. The line was the world's first to be constructed with the carriage of passengers as one of its main functions. It was also arguably the world's first true inter-city railway.

The original plans for the railway would have seen a station developed on the west side of the River Irwell in Salford. However the line's promoters wanted to have a terminus in Manchester proper which would save passengers from having to cross the river.

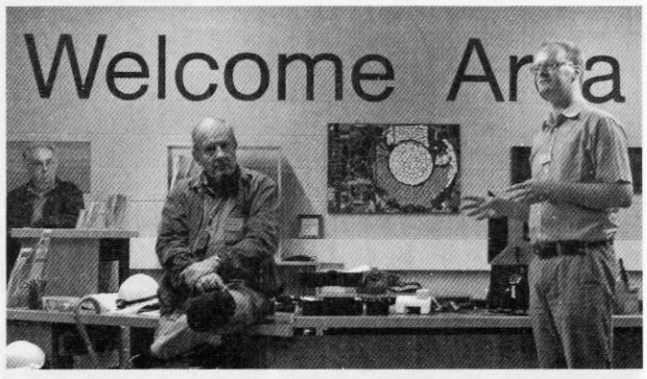
A site was identified and purchased at Liverpool Road on the western edge of the city and a handsome two-storey stone building was constructed next to it to cater for passengers. To reach the site, the line had to be raised sufficiently for a bridge across the Irwell which would still allow commercial navigation; this brought the line into the station level with the first storey of the building.

In comparison to the goods facilities, the passenger facilities were minimal. A fine brick warehouse was provided opposite the departure platform. Within seven years four more warehouses were added which demonstrates the phenomenal success of the line.

By 1844 the station was far too small to cope with the passenger numbers. By this time trains were travelling to more destinations than just Liverpool. A new station (Victoria) opened further to the east and Liverpool Road closed to passengers. The station site continued to be developed as a goods facility.

The station closed completely in 1975; however in 1980 it was used to celebrate the 150th anniversary of the Liverpool and Manchester Railway. Locomotives visited from all over the country and the local authority had the idea of creating a Science and Industry Museum which would preserve and make good use of the site. Today that museum is known as the Manchester Museum of Science & Industry (MOSI), our venue for the morning.

There we were met by our host, Senior Curator (and Sub Brit member) John Beckerson, who gave us a brief introduction to the museum and its collections. Then we had time to explore 'Store 1' – a small part of a 60,000-item collection and not normally seen by the general public. There was also an opportunity to see and touch some mining items from the handling collection.



John Beckerson (right) from MOSI and an attentive Sub-Britter. Photo Richard West

This was followed by a talk by Keith Warrender, author of two books about subterranean Manchester –

Underground Manchester and *Below Manchester* – both of which are highly recommended. Keith described some of the fascinating research he had done to get material for his books; he was to stay with us throughout the day and his knowledge was invaluable.

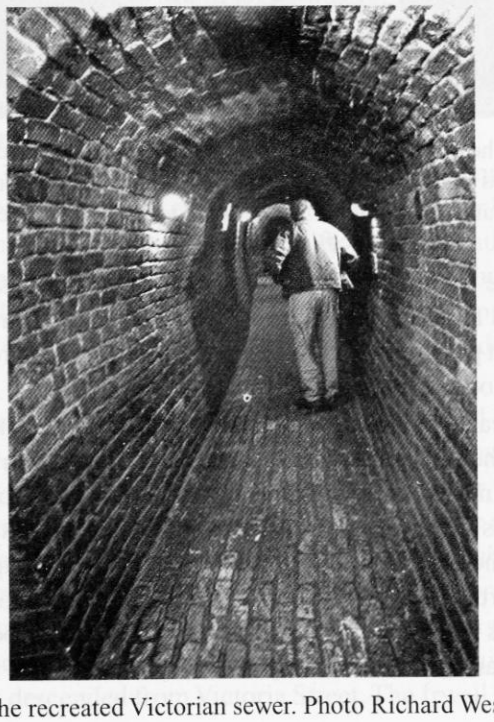
We were then split into two groups – one clean, for the Underground Manchester Gallery, and one dirty for the Stephenson Arches – with a swap-over at half-time, so everyone saw everything.

Stephenson Arches & the Underground Gallery

The 1830 Viaduct was built by George Stephenson in his capacity as Chief Engineer of the Liverpool & Manchester Railway Company. The skewed River Irwell and Water Street bridges dictate the shallow curve of the viaduct on the station site, which, together with the massive brick arches, characterises the structure. The floor level of most arches is at the level of the 1830 warehouse and station building basements. A raised floor permitted access between the lower yard and Liverpool Road through two of the arches.

Originally the upper level extended straight into the shipping shed. In about 1867 an extension with a curved brick outer wall was added to its northern face, supporting rail tracks leading to the north side of the upper yard. This blocked off some of the eastern arches. Arches on the northern side were used for storage, workshops and stabling. Since 1982 the western arches have been incorporated into the exhibition space and provide a connection between the 1830 warehouse and the station building.

First up for our group, in clean gear, was the Underground Manchester gallery, in the basement of the 'oldest railway station in the world'. The exhibits aim is to show why clean water and effective sewage removal were essential to public health.



The recreated Victorian sewer. Photo Richard West

You walk through a Victorian sewer, built using original bricks from a Manchester sewer of the late 1830s. We were elicited to 'Explore the history of the toilet through exhibits including a real Victorian privy'. All good clean (sanitised)) fun.

Then into our underground gear and boots for our visit to the Stephenson Arches. These were another matter altogether, meeting all our grubby underground expectations. They are abandoned brick arches upon which the Liverpool & Manchester railway line was constructed, and now lie within the MOSI site.

Sub Britters disappearing down a hole underneath the arches. Photo Clive Penfold

The arches are blocked off, damp, dark and very mucky – great! John Beckerson had helped us arrange access as they are normally strictly off-limits. We explored at slippery leisure; the only downside was that we had to hose down afterwards before being allowed back in to the museum – well, our boots at the very least!

There followed an excellent buffet lunch at the MOSI Conference suite. Keith Warrender was also on hand signing copies of his latest book – now where have I seen that before (and since!).

Divided into two groups once more, we had some free time to explore MOSI and, despite the crowds attending a *Thomas the Tank Engine* weekend, managed to get on to the platform of Liverpool Road station. MOSI is huge (five buildings) and there really is a lot to see, far more than we could cover in the time available – it's on my list to revisit.

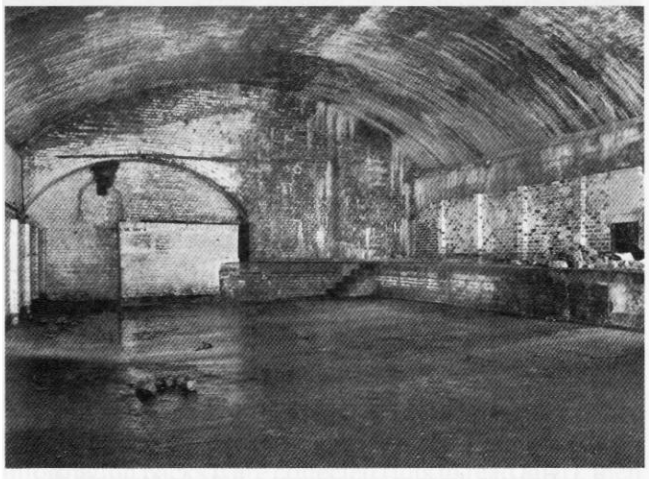
The groups then swapped over and we were off to the Manchester and Salford Junction Canal, a short walk away. We entered through an anonymous-looking door in a shopping precinct – just what is to be expected from these trips. The canal tunnel was last visited by Sub Brit during the 1994 weekend – for a few members this was a second visit.

Manchester and Salford Junction Canal

The Manchester and Salford Junction Canal was opened on 28 October 1839 linking a short branch of the Rochdale Canal close to the city centre with the River Irwell, with around half of its short length (499 yards) in a tunnel.

With easy alternative routes available, the new junction canal did not attract the estimated trade. It was beset with problems from the start and maintenance costs were considerably more than revenues from tolls.

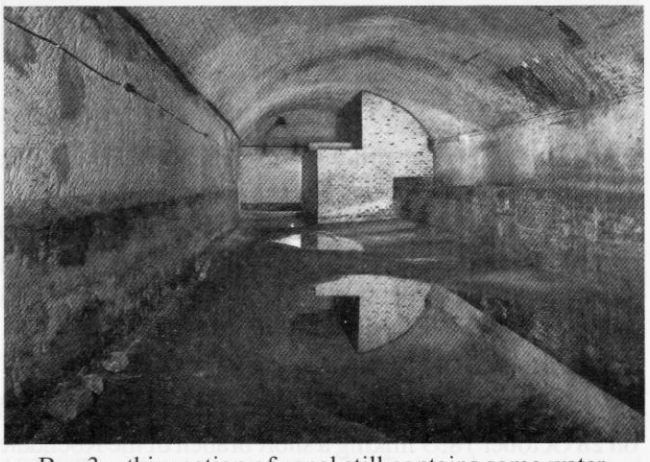
Half the cost of maintaining the canal was paid by the Mersey and Irwell Navigation and in 1842 they were induced to take over the canal and its debts. The new owners added wharfs and basins to the Irwell and brought in additional traffic and revenue making the river navigation a much more valuable acquisition when it was bought for the Bridgewater Canal trustees a few years later.



The transhipment dock (Bay 2) Goods from the Great Northern warehouse above were loaded onto boats here. Photo Nick Catford

Once the junction canal had become the property of the Bridgewater, it lost its value as a competitive route. When the Cheshire Lines Committee decided on their Manchester terminus at Central station in 1872, they first planned to build it over the canal, but instead filled in the eastern end and through traffic along the junction canal ceased.

When the Great Northern Railway goods depot was built over the tunnel in 1899, two shafts were sunk 25ft down to the canal for the interchange of goods between the five levels of the railway warehouse and the docks of the Manchester Ship Canal via the Irwell. This traffic continued until 1922 and the remaining length of the canal was abandoned in 1936.



Bay 3 – this section of canal still contains some water. Beyond the blast wall is Bay 4, here the water is too deep for further progress through the shelter. Photo Nick Catford

During World War II, the canal tunnel was brought back to life as a public air-raid shelter. It took five days to drain it. Following the removal of 4,000 cubic yards of silt, a concrete floor was laid in the old canal bed which was divided into bays, each separated by offset parallel brick walls for protection against blast.

Today the only easily accessible traces of the expensive and little-used junction canal are the exit to the Irwell and the link with the Rochdale above lock 89. However the tunnel remains intact although hidden from view. It is now divided into two parts, one part lying beneath the Granada TV studios and the other longer section under the former Great Northern Warehouse; both are accessible.

The Grade II* listed Great Northern warehouse has been redeveloped as a car park, shopping centre and leisure complex. It is a unique survival of a former three-way railway goods exchange station, serving the railway, canal and road networks of the Manchester region.

Sub Brit visit

In 1994 the canal tunnel was entered using a 25-foot vertical ladder (still extant) but due to Elphan SafeTea we had to use the door and a newly sunk shaft instead – shame, but at least access had been preserved by the shopping centre constructed on top. But at least a similar mishap to the one that occurred in 1994 was avoided. On that occasion Nick Catford was climbing down the ladder with a canvas bag full of heavy batteries over his shoulder. The strap broke and the bag plummeted, landing on another member's shoulder! (Sorry, Ken)

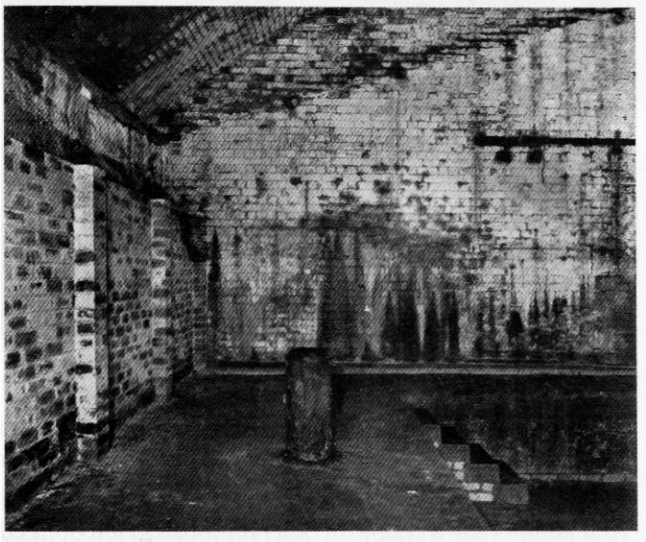
The drained canal bed was converted into numbered bays separated by blast walls during its conversion into an air-raid shelter. Some signage remains in place. Photo Martin Dixon

There is much evidence remaining of the tunnels' reuse as an air-raid shelter during WWII. We negotiated the offset parallel brick walls and explored until we reached the flooded section.

The canal tunnel has changed dramatically over the years and the east portal which can still clearly be seen is now itself more than 25 feet underground, surrounded by brick arches and walls built to support the Great Northern goods warehouse above. Two vast brick pillars rise upwards towards the roof; these are the remains of the two winch shafts installed for the trans-shipment of goods between the canal and the railway.

The tunnel mouth has been partly bricked across with steps down to the canal bed and a raised towpath along the north side. There is a small brick building in the canal bed just inside the tunnel mouth – this was once a WWII shelter warden's post. There are three accessible bays with bay numbers still clearly visible on the dividing blast walls.

Bay 2 is the underground trans-shipment dock; here the tunnel opens out into a huge vaulted chamber with the towpath running around three sides; there is even a mooring bollard alongside the dock. An arched doorway leads to stairs up to the warehouse; this was blocked in 1994 but is now the way into the tunnel down a long spiral staircase. In Bay 3 the canal bed contains several feet of water but it is still possible to walk along the towpath as far as the next blast wall where there is an arrow pointing to Bay 4. The depth of water made further exploration impossible and we had to retrace our steps.



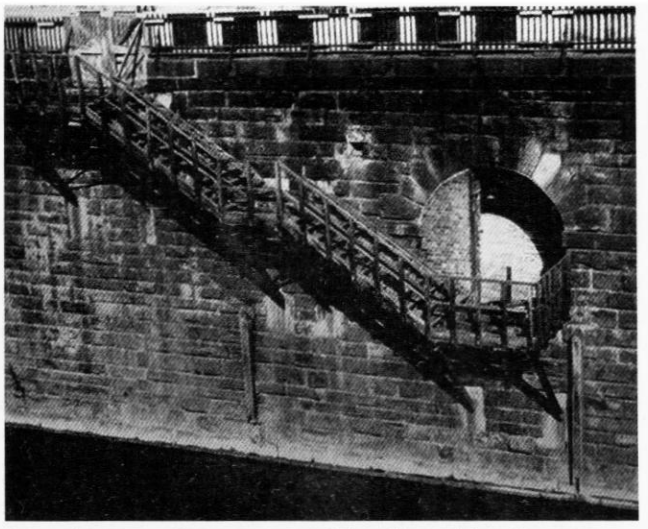
Mooring bollard in the transhipment dock (Bay2).
Photo Nick Catford

Then it was back to MOSI to regroup for the walk to the cathedral steps and our visit to the famed Victoria arches. This was probably the highlight of the trip for me (not the walk! – the arches).

Victoria Arches

In 1838 the Manchester city authorities completed construction of a new embankment along the River Irwell, designed to support a new road in front of the Cathedral to improve traffic flow. The embankment was built on land sloping down from the Cathedral; it was supported on seventeen arches, which created vast new industrial space beneath the road.

The land covered by the arches included an old street, which led at the west end to a wooden bridge over the River Irk. The old road was covered over in an improvement scheme, which began in 1833. The arches were advertised in October 1839 as being suitable for wine merchants, printers and machine-makers. From 1895 the arches also acted as landing stages for steam packet riverboats and were accessed from wooden staircases which descended from Victoria Street. The Irwell Steam



Wooden steps down to one of the disused landing stages. Note the arch has now been blocked.

Ferries would run at half-hour intervals to Manchester Docks, via Albert Bridge. There was also a cruise along the newly opened Manchester Ship Canal and special Bank Holiday sailings to Liverpool and New Brighton.

The stages suffered problems with flooding of the Irwell, and do not appear to have remained in business for long; they were closed in 1906 and the arches were then used for general storage.

Wartime use

During World War II, the arches were made available as an air-raid shelter for people within ten minutes' walking distance. It was estimated that if unventilated, the shelter could accommodate 1,030 people for six hours but if ventilation were installed, this number could rise to 5,600.

Three entrances were proposed, each fitted with gas-proof doors. These were from Victoria Bridge by a wooden stairway; from the junction of Victoria Street and Fennel Street by a flight of steps from the street; and from the Cathedral approach by means of a wooden stairway from the existing public toilets. The openings overlooking the River Irwell would also be filled in and made gas-proof.

Benches in the air-raid shelter in 1940

The scheme received Home Office approval on 25 October 1938. A report in January 1939 recommended the installation of a forced-air ventilation system which would provide blast and splinter protection for 3,300 people at a cost of £8,000 (later revised to £10,150); the work took three months to complete.

The arches were declared safe and suitable for use as an air-raid shelter even though the overhead cover above the crown of the arches was only between 3ft 9in and 7ft 6in. At this depth, a direct hit from a 500lb MC bomb would have penetrated the shelter.

During the early years of the cold war the arches were once again considered for use as a shelter and were inspected for this purpose in May 1951. At this time water, electricity and sewage systems were still found to be working in Arch 4 but had been disconnected from the other arches. It was estimated that the shelter could accommodate a total of 1,619 people with 562 on bunks and 1,057 seated. The estimated cost for the conversion work was £3,622 but no further action was taken.

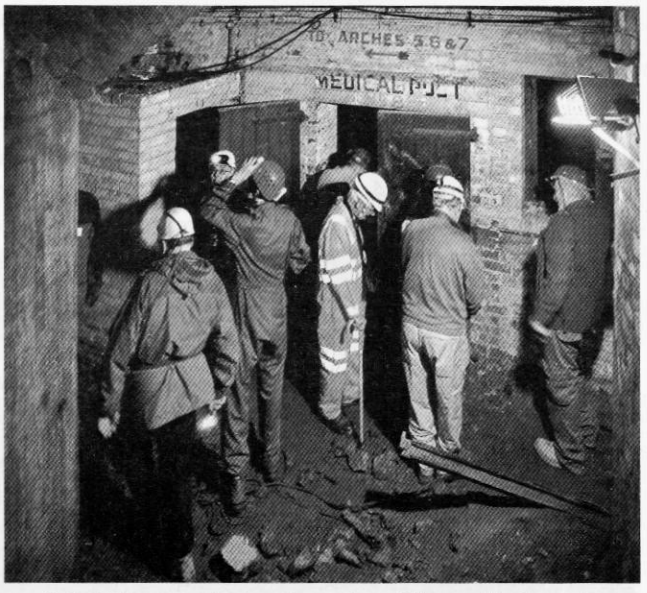
The only access is now through a locked manhole in the street above. By the time everyone got in we had attracted a small crowd of onlookers. Photo Martin Dixon

The Irwell stages also connected with underground public toilets that used to be in front of the Cathedral; these remained open after the war, finally closing in 1967 when the remaining entrances were securely sealed. The arches have remained the responsibility of Manchester City Council Highway Services ever since – they are visible from the three surrounding bridges, and from the northwest shore of the river. Open ends are all bricked up, some with small ventilation apertures left in place.

Sub Brit visit

Due to our old friend Elphan we were escorted, and counted in and out, by Underground Surveys, a company arranged by Martin and used by Manchester Council to monitor underground sites; their presence, and gas testing, was one of the conditions of entry. It took a long time to get us all down through the small hatch in the pavement – a manhole specially opened for us. Needless to say we soon had a small crowd of curious passers-by watching our antics!

There was a huge amount to explore under the arches with the remains of the conversion to shelters in World War II and something like 28 separate 'rooms' to investigate. Although many of the wartime posters and signs that were still in place a few years ago have sadly disappeared in recent years, there was still plenty to see including painted signs, rusty electrical fittings, smashed ventilation trunking and the public toilets that remained in use until 1967. We had plenty of time and really did justice to this amazing survival from the 1830s.



Sub Britters exploring the arches. The medical post is through the doors. Photo Clive Penfold

On the way back I visited a bar in a (subterranean) public toilet – (thanks to the MarLin info pack). The *Temple of Convenience* had a large selection of bottled beers which your author (and a couple of other reprobates) felt obliged to sample.

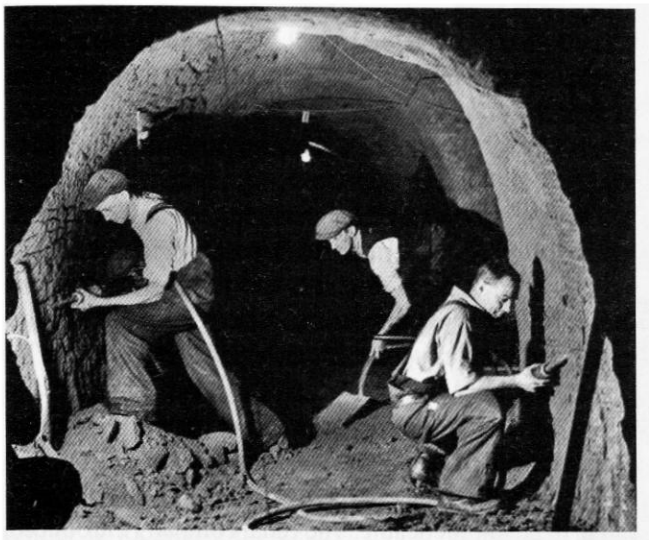
Then back to the *Campanile* for the extended three-course conference dinner, a few speeches, a few more drinks and then finally a well-earned bed.

Sunday 4 September – Stockport Air-Raid Shelters

Another big breakfast and then on to the coach for a private tour of the famous Stockport Air-Raid Shelters, another site that was first visited during the 1994 Manchester weekend.

Stockport's tunnel air-raid shelters were constructed between 1938 and 1939 during the lead-up to World War II. The Chestergate shelter (one of four separate tunnel shelters in the town) consisted of a series of tunnels cut into the red sandstone; the soft stone meant tunnelling was relatively easy. The Chestergate tunnels were officially opened in October 1939, with room for four thousand people.

At first, they were little used, but when the blitz on London and other cities began in the autumn of 1940, the tunnels came into their own. Stockport Council announced at the end of October that the tunnels were to be extended to provide accommodation for 7,000 and that bunk beds would be installed.

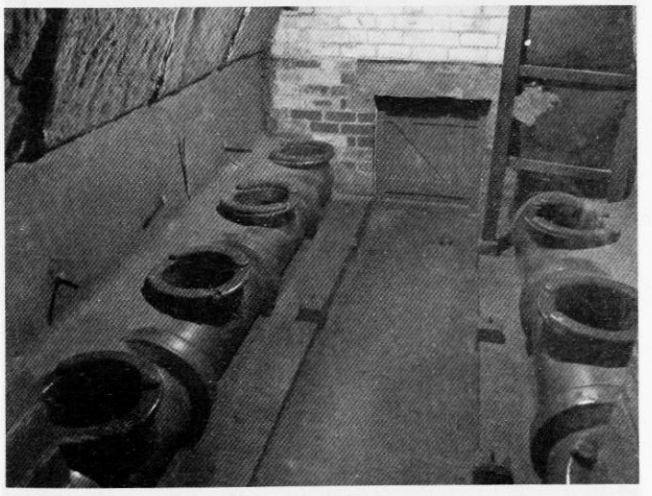


One of the Stockport shelters under construction in 1939

Stockport residents complained that the bulk of the space in the tunnels was taken up by Manchester people and that many local residents were unable to get in. In an effort to stop this practice, the Council introduced a ticket system and people wrote applying for tickets, often explaining they had used the shelter regularly since being bombed out of their homes and stating which particular part of the tunnels they went to each night.

The tunnels were 7 feet wide and high and had electric lighting and wooden bench seating. There were toilets, mostly chemical, although a few were plumbed into the mains including the infamous 16-seater. A warden's post, a first-aid store and a tool store were also provided. Ironically, during the war the shelter was nicknamed the *Chestergate Hotel* because of the 'luxurious' standard of accommodation that was offered.

As the threat of bombing receded in 1943, it was decided that the tunnels no longer needed to be open every night. After the war the shelters were sealed with much of the contents still inside. In 1996, in a far-sighted move, Stockport Council opened the Chestergate tunnels as a tourist attraction – they have proved a great success and won several awards.



One of the infamous 16-seater toilets. Photo Clive Penfold

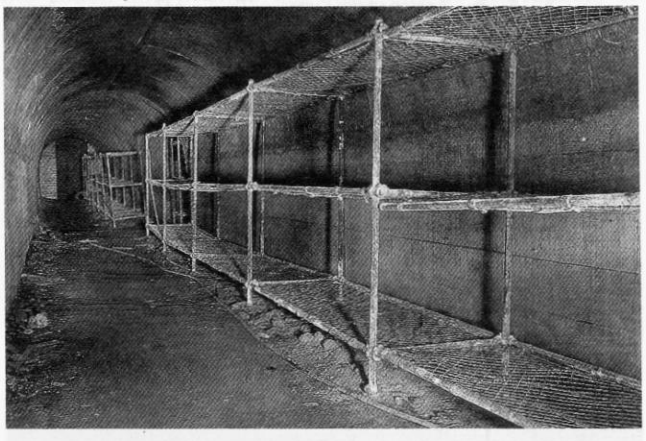
Sub Brit visit

Again, we split into two groups. The tour started for my group with the tourist introductory film and tunnels 'experience' sound-effects during an air raid. Not helped by the rather sceptical audience and the odd cynical comment during the 'experience.' We had an excellent guide who knew the history of the tunnels well and brought to life what it must have been like to use the shelter.

There are a lot of tunnels in this shelter at Stockport but only small parts of them are lit and available for public tours. Then there are the lit but off-limits tunnels and then the unlit and even more off-limit tunnels. Needless to say we saw them all. The tunnels were full of rusting, but intact, one-up, one-down original bunk frames and almost every tunnel was lined with them in varying states of decay.

This felt a lot more authentic than the tourist experience tunnels which although very well done (the 'hospital' being a good example) were far too well lit and public for Sub Brit!

Then back on the coach to pick up packed lunch (provided by our hotel), and, depending on which group you were in, head to Standedge canal tunnel or on to Diggle for the rail tunnel. Both groups did get lunch – but one waited longer than the other! We were to explore the canal tunnel and the two disused rail tunnels (the fourth still carries a live railway line!).

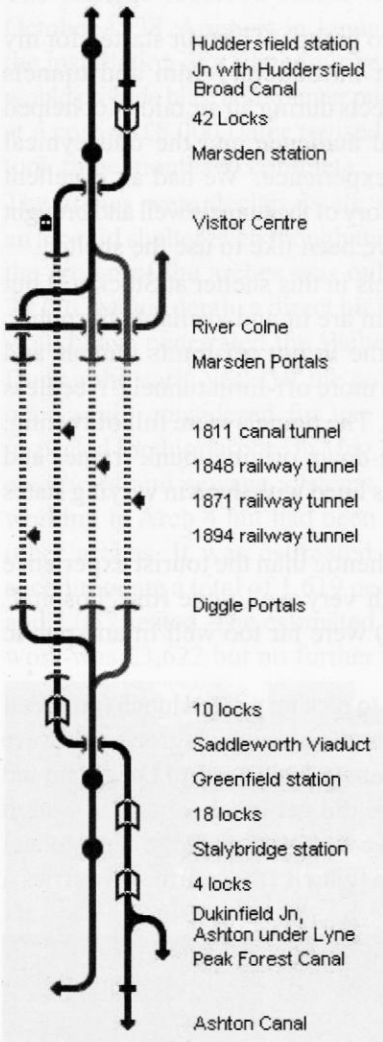


Rusting bunks in one of the unlit tunnels. This area is not normally open to the public. Photo Nighthawk

The Standedge tunnels

The Standedge Tunnels (normally pronounced *Stannidge*) are four more or less parallel tunnels that run beneath the Pennines between Marsden and Diggle, on the edges of the conurbations of West Yorkshire and Greater Manchester. There are three railway tunnels and a canal tunnel; the latter is the longest and oldest of the tunnels, and holds the record as the longest and highest canal tunnel in Britain. It is 16,499 ft long, 636 ft underground at the deepest point, and 643 ft above sea level. All four tunnels are linked by cross-tunnels.

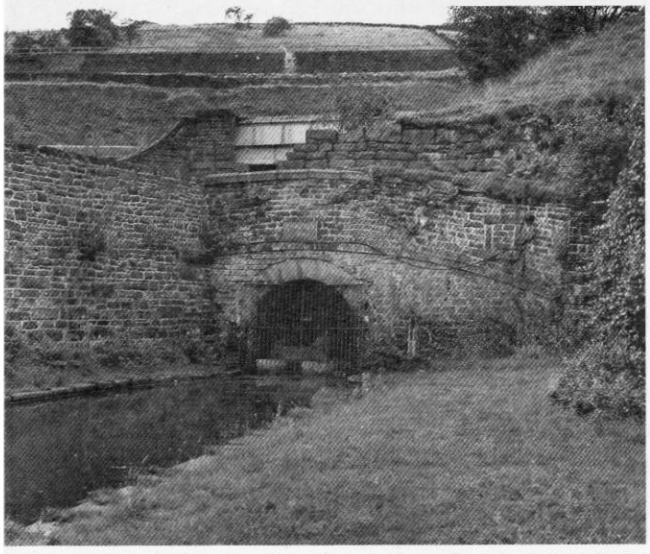
The Huddersfield Narrow Canal (then known as the Huddersfield Canal) was authorised by an Act of Parliament on 4 April 1794, to link the towns of Ashton-



under-Lyne and Huddersfield. The canal's engineer was Benjamin Outram, and he foresaw no difficulties with the construction as the hill through which the tunnel was to be cut was composed of gritstone and strong shale. Work started at both ends using steam engines to keep the tunnel drained.

By mid-1796, 795 yards of tunnel had been cut, some of which had been lined, but much effort had been spent on constructing small tunnels to supply waterwheels, which would raise spoil and water from the intermediate adits. Tunnelling was hampered by much larger quantities of water entering the workings than had been expected. By the middle of 1799, 1,000 yards of the tunnel had been finished, and a further 1,000 yards had been excavated but not completed.

After problems finding suitable contractors which led to the departure of Outram in 1801, Thomas Telford was employed as a consultant. His plans were followed to the letter and the two ends finally met on 9 June 1809.



The east (Marsden) portal of Standedge canal tunnel in 1979 before it had reopened. Photo Nick Catford

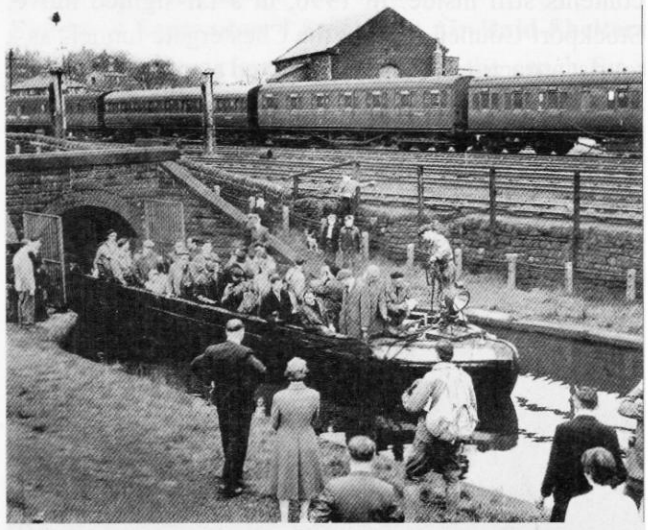
On 26 March 1811, the tunnel was declared complete, with a grand opening ceremony on 4 April, thirteen years after the rest of the canal had been finished. Between 1811 and 1840 the tunnel was used on average by forty boats daily.

The tunnel was brick-lined in places, though bare rock was left exposed in others. Although the company had hoped to provide a towpath this was prohibitively expensive. The tunnel was only wide enough for one narrow boat for much of its length and boats had to be legged through.

There are several wider points in the tunnel, originally designed to be passing places. However, due to intense competition between boat crews, two-way operation was found to be impracticable. The canal company introduced a new method of working where one end of the tunnel was closed-off by a locked chain, preventing access unless authorised. A similar system is used today.

The Huddersfield Narrow Canal was purchased by the Huddersfield and Manchester Railway in 1846. The canal tunnel proved most beneficial in assisting with the construction of the first railway tunnel, as no vertical shafts were needed in its construction as the canal provided an easy way to remove the large amount of spoil excavated. Several cross-passages were retained for ventilation and emergency escape.

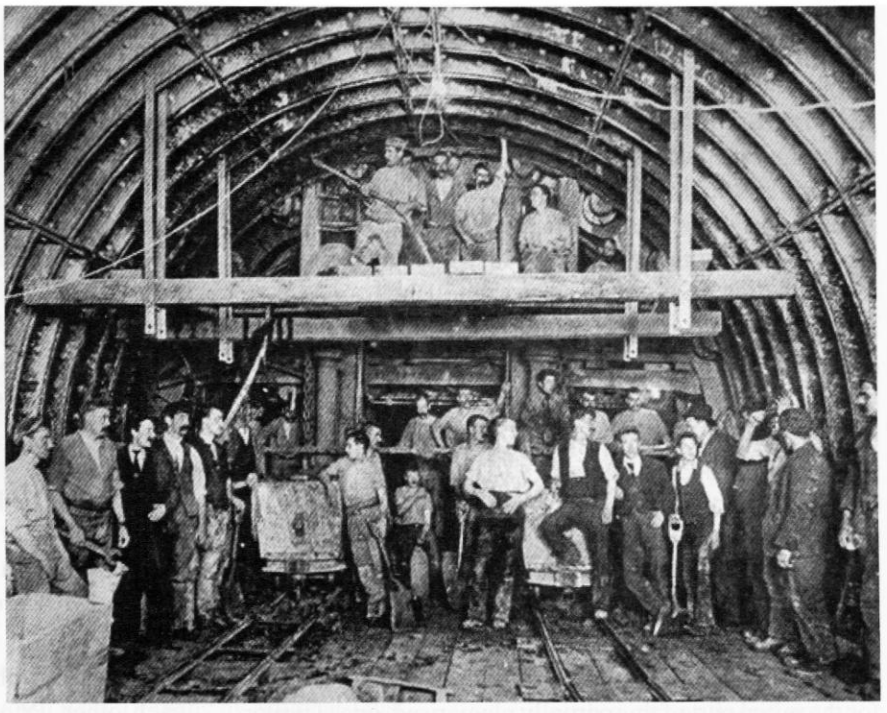
The last commercial boat to use the tunnel passed through in 1921, and the canal was officially closed in 1944, after which it soon fell into disrepair. The tunnel always remained navigable although in the 1950s it was considered to be unsafe, and was closed off by large iron gates at each end. In 1961 there was a special trip through the tunnel organised by the Railway and Canal Historical Society to commemorate 150 years since building work on the canal was complete.



A special trip was organised by the Railway and Canal Historical Society in 1961. This was to commemorate 150 years since building work on the canal was complete. The boat is shown on exit from the Western portal at Diggle

In the 1990s the canal tunnel was the beneficiary of a £5 million restoration project as part of an effort to reopen the entire canal. Several rock-lined parts of the tunnel were found to be unstable. Where possible, these were stabilised by rock bolts, or where impractical, concrete was used. The tunnel reopened in May 2001.

The 1848 railway tunnel was completed by the London and North Western Railway, having acquired the former Huddersfield and Manchester Railway in 1847. This was a single-line tunnel with a length of 3 miles, 57 yards. The tunnel is located immediately to the south of, but at a slightly higher level than, the canal tunnel. This tunnel soon proved to be a bottleneck for rail traffic, and in 1871 a second parallel single-line tunnel was opened.

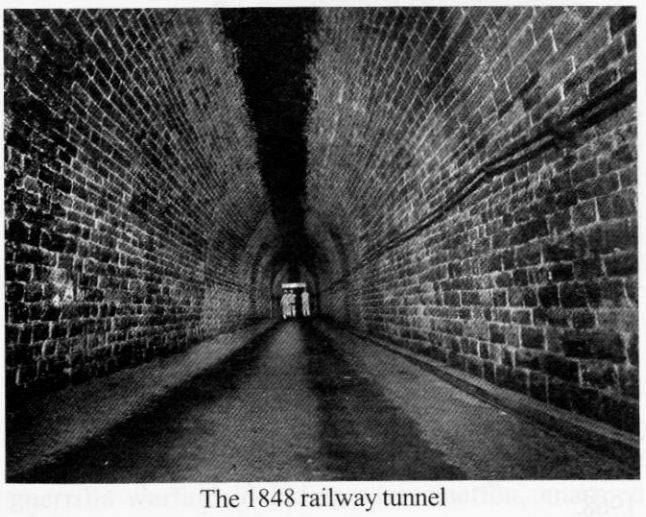


The Cathedral crossover tunnel during construction

The 1894 twin-bore tunnel was opened by the London and North Western Railway. For most of its length, it is situated to the north of the canal tunnel, but passes over the canal tunnel just inside each tunnel entrance. This tunnel is the fifth-longest rail tunnel in Britain. Today this is the only rail tunnel that is still used, although all three rail tunnels are maintained. The 1848 tunnel is used to provide an emergency escape route for the other tunnels, and has been made accessible to road vehicles such as fire engines and ambulances.

Sun Brit visit

Our trip to the Standedge Canal tunnel began with a look around the visitor centre in the former canal warehouse opposite the towpath at Tunnel End (Marsden). The exhibition told the story of the canal and tunnel but the highlight was the trip through the tunnel itself. By a bit of careful planning, we packed the narrow boat from the front. Those of us at the open ends had to wear hard hats and had an excellent view as we moved slowly into the tunnel past the original entrance some ten metres inside.



The 1848 railway tunnel

The boat had lights facing out which made it easy to see the construction of the tunnels and take lots of photographs. We had a chance to look through the cross-passages linking to the railway tunnels. We travelled about 500 metres in then it was back out in reverse and onto the coach and over to the other end of the tunnels at Diggle.

Standedge Railway Tunnels

For the railway tunnels we had to suit up with full orange hi-vis (as approved by Network Rail and provided by Sub Brit) tops and bottoms, hard hats and safety boots for the accompanied walk-through.

The safety briefing warned us to stay with our guide and not to wander off into side tunnels as you can either end up in the canal or on the live rails. Then it was up the 1848 tunnel for a mile and a half to the halfway point where we could cross over and walk back down the 1871 tunnel to the entrance.

The main crossover is known as the 'Cathedral' and has an architectural grandeur well above the strict needs of an underground junction. Dave Carrington of Network Rail led the groups – he had put in a huge amount of work to overcome normal Network Rail practice and we are grateful to him for that. We were shadowed by a Network Rail car in case of any accidents (the tunnel is also used to follow canal traffic through). As we emerged from the tunnel and thanked our guides a brass band was playing at a local pub – a fine regional touch.

Then it was back to the *Campanile* hotel for goodbyes and the weekend was over. Overall another well organised, supported and enjoyable weekend packed with interesting and diverse places and spaces. I went home tired but very happy with my weekend away – and looking forward to the next one.

The Coleshill Estate – 2011

By Alex Horsfall-Turner

Subterranea Britannica has recently been involved in two underground aspects of the Coleshill Estate near Swindon. The first is an archaeological study of the estate, exploring its use as the training centre for the World War II Auxiliary Units. Secondly, the cellars and a fascinating water supply tunnel network beneath the now demolished house have been surveyed and recorded. Both activities were undertaken in partnership with the National Trust, who now owns the estate, and other special interest groups. **Alex Horsfall-Turner** who led Sub Brit's involvement, takes up the story.

The Auxiliary Units

I've tried to come up with a better way of describing the background to the Auxiliary Units and their connection to the Coleshill Estate, but after much deliberation and possibly idleness on my part I shall be drawing directly on the excellent Wikipedia article on **Auxiliary Units** for the initial part of this partially plagiarised, or as I prefer 'team-conceived', article. Some things are best left to the experts I feel! In any case, the expertise within Subterranea Britannica on the subject also fills me with a sense of fear of being corrected upon any errors.

At a basic level

The Auxiliary Units were created during World War II in order to provide crack teams of highly trained individuals, skilled in local knowledge, guerrilla warfare, sabotage, assassination and other nefarious tactics designed to resist a possible German occupation. The end result was a highly secretive force that one might liken to a Special Forces version of the Home Guard. In fact, the Auxiliers were issued with Home Guard uniforms in order to provide cover against suspicion, or in case of enemy capture, despite the fact that they were not part of the Home Guard.

Now to the experts

The Auxiliary Units or 'GHQ Auxiliary Units' were specially trained, highly secret units created by the British government during World War II, with the aim of resisting the expected occupation of the United Kingdom by Nazi Germany, after a planned invasion codenamed *Operation Sea Lion*. Having had the advantage of seeing the fall of several Continental nations, the United Kingdom was the only country during the war that was able to create such a resistance movement in advance of an anticipated invasion.

The units, sometimes referred to as a part of the British Resistance Organisation, were initiated by Winston Churchill in the early summer of 1940. He appointed Colonel Colin Gubbins to create them. The Auxiliary Units answered to GHQ Home Forces, but were organised as if part of the local Home Guard.

Colonel Gubbins was a regular British Army soldier who had acquired considerable experience and expertise in guerrilla warfare during the Allied intervention in the Russian Civil War, and the Anglo-Irish War. Most recently, he had returned from Norway, where he headed the Independent Companies, the predecessors of the British Commandos. Subsequently, he would move to the Special Operations Executive (SOE). Gubbins used several officers who had served with the Independent Companies in Norway, plus others he had known there.

Colonel Gubbins

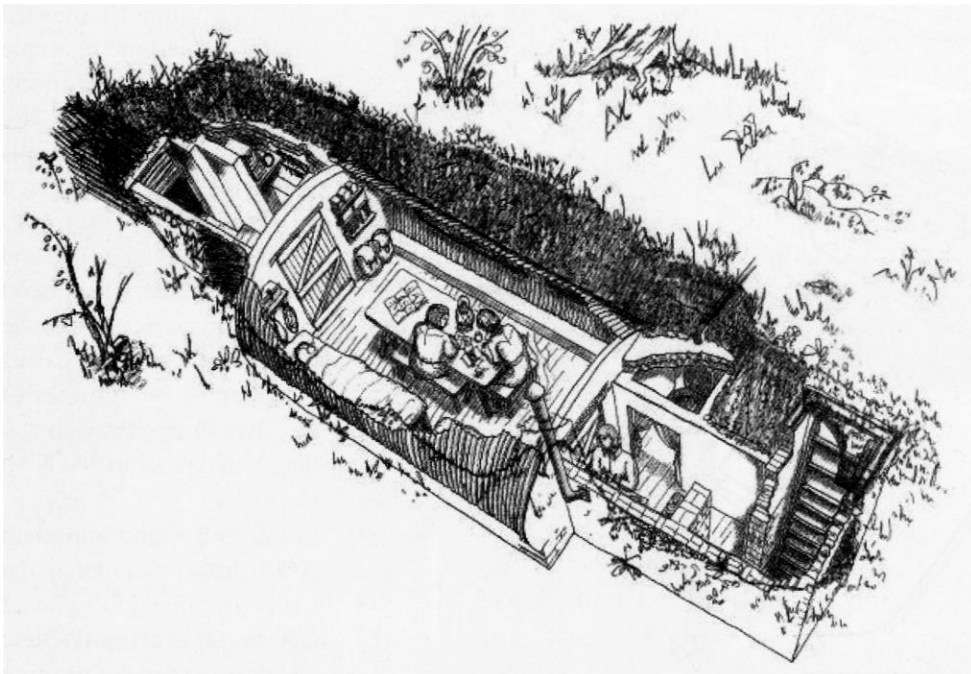
Auxiliary Units were localised on a county structure, as they would probably be fragmented and isolated from each other. Priority was given to the counties most at risk from enemy invasion, the two most vulnerable being Kent and Sussex in the southeast. The two best known officers from this period were Captain Peter Fleming of the Grenadier Guards and Captain Mike Calvert of the Royal Engineers. Fleming came from a well-known banking family and was the elder brother of author Ian Fleming. Calvert had recently served in the 5th Battalion, Scots Guards, which had been formed to fight as a ski-troop in Finland. Both of these men were too valuable to stay long, once the immediate threat of invasion was over, and both later served in Burma – Fleming in deception work, Calvert in the Chindits.

Nationwide organisation

The 'combat units' were the Operational Patrols, but these were supported by Special Duty Sections, from the local civilian population. This group acted as the spotters for the action teams. In addition, a signals structure would attempt to link the isolated bands into a national network that could act in concert, on behalf of a British Government-in-exile and its representatives still in the UK.

Some tales attached to the Auxiliary Units are of varying degrees of credibility. Members were supposedly vetted by a senior local police chief who was allegedly, according to sealed orders given to the Operational Patrols to be opened only in case of invasion, to be assassinated to prevent the membership of the Auxiliary Units being revealed!

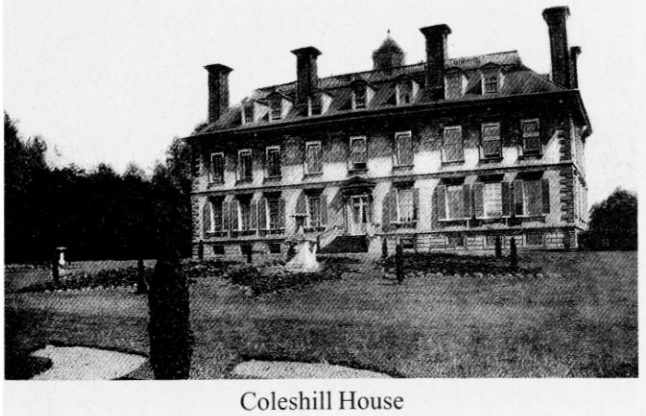
The Auxiliary Units were kept in being long after any immediate Nazi threat had passed and were stood down only in 1944. Several Auxiliary Unit members later joined the Special Air Service; many men saw action in the campaign in France in late 1944. The units' existence did not generally become known by the public until the 1990s, though a book on the subject was published in 1968.



A typical underground Operational Base. Drawing by National Trust

The Special Duty Sections were largely recruited from the civilian population, with around four thousand members. They were trained to identify vehicles and aircraft, high-ranking officers and military units, and were to gather intelligence and leave reports in dead-letter drops. The reports would be collected by runners and taken to one of over two hundred secret radio transmitters operated by trained civilian Signals staff.

Operational Patrols consisted of between four and eight men, often farmers, gamekeepers or landowners and usually recruited from the most able members of the Home Guard, who also needed an excellent local knowledge and the ability to live off the land. As cover, the men were allocated to "Home Guard" battalions 201 (Scotland), 202 (northern England), or 203 (southern England) and provided with Home Guard uniforms, though they were not actually Home Guard units.



Coleshill House

Basic training

Around 3,500 such men were trained on weekend courses at Coleshill House, near Faringdon on the Oxfordshire/Wiltshire border, in the arts of clandestine guerrilla warfare including assassination, unarmed combat, demolition and sabotage. Recruits for Coleshill reported to the post office at nearby Highworth, from where the postmistress Mabel Stranks arranged by telephone for their collection and transfer to Coleshill's secret location.

Each Patrol was a self-contained cell, expected to be self-sufficient and operationally autonomous in the case of invasion, generally operating within a fifteen-mile radius. They were provided with a concealed underground Operational Base (OB), usually built by the Royal Engineers in local woodland, with a camouflaged entrance and emergency escape tunnel; it is thought that 400 to 500 such OBs were constructed. Some Patrols had an additional concealed Observation Post.

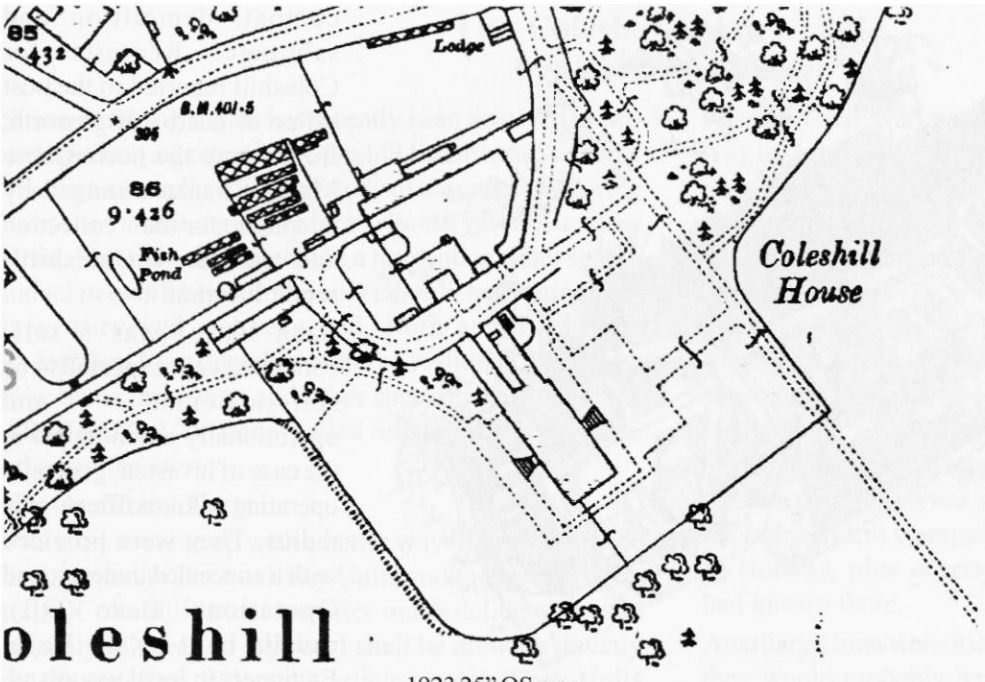
Patrols were also provided with a selection of the latest weapons including a silenced pistol or Sten Gun and Fairbairn-Sykes "commando" knives, quantities of plastic explosive, incendiary devices, and food to last for two weeks. Members anticipated being shot if they were captured, and were expected to shoot themselves first rather than be taken alive.

The mission of the units was to attack invading forces from behind their own lines while conventional forces fell back to the last-ditch GHQ Line. Aircraft, fuel dumps, railway lines, and depots were high on the list of targets, as were senior German officers. Patrols secretly reconnoitred local country houses, which might be used by German officers, in preparation.

The Coleshill Estate

Coleshill House, the seat of the Pleydell-Bouverie family, had been built by Sir Roger Pratt in 1660, under the advice of Inigo Jones. During WWII, Coleshill House was chosen by Colonel Gubbins because its large parklands and woods made it very suitable for guerrilla training. Gubbins had sent Major the Honourable Michael T Henderson to scout around the country for a suitable HQ after the Luftwaffe blitzed the cramped offices in Whitehall Place, Westminster. Henderson soon discovered that Coleshill, the country estate adjacent to that of his brother, was qualified in all respects as a potential HQ. Coleshill's owner was the Earl of Radnor, but only the Earl's two Pleydell-Bouverie sisters and their dogs occupied the house.

Sadly, Coleshill House was burnt down in September 1952 following an accident with a contractor's blowlamp



1923 25" OS map

The area around Coleshill House is a unique example of a World War II training landscape. Used by the nascent British guerrilla units during the early war years, it provides an opportunity to study the material, social and cultural aspects of a secret military organisation. The site and the surroundings landscape bear witness to the British response to the threat of invasion by Nazi Germany.

Currently the most important WWII feature known on the site is the almost fully intact OB or Operational Base which was used for training the Auxiliers. The OBs were generally built to a standard design using a cut and cover method. They comprised an underground chamber, roofed with corrugated iron; the end walls were brick, with a brick shaft at one end leading to the main entrance, and an escape tunnel at the other end. The shaft was concealed by a camouflaged trap-door. Brick blast walls were located at the bottom of the shaft so as to absorb any potential damage from grenades thrown down.

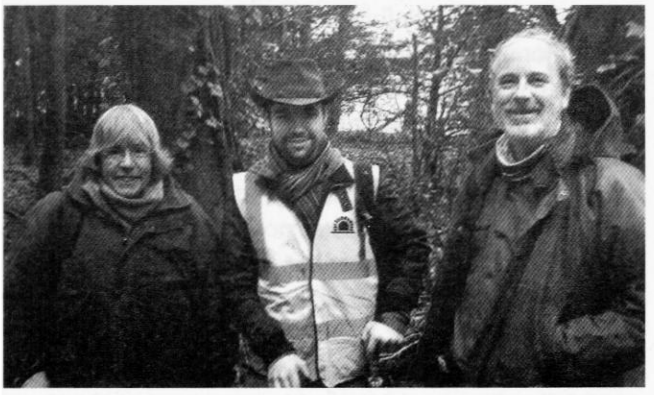
OBs also had a toilet area, drainage gulley, bunk spaces, stores, ladder access and also a cooking stove with a concealed chimney. Since OBs were almost always in wooded areas, it was feasible to conceal the chimney within a hollow tree trunk which was held vertical by a concrete base. This would direct cooking smells above the tree line to reduce the likelihood of detection.

and the site and grounds are now managed by the National Trust. The site has been investigated by a number of historical groups in the past who have uncovered an original underground Operational Base which was used for training the Auxiliers. Evidence suggests that there may be more of these in the Coleshill grounds and the desire to search for these formed part of the initial plans for creating the *Coleshill Uncovered* project.

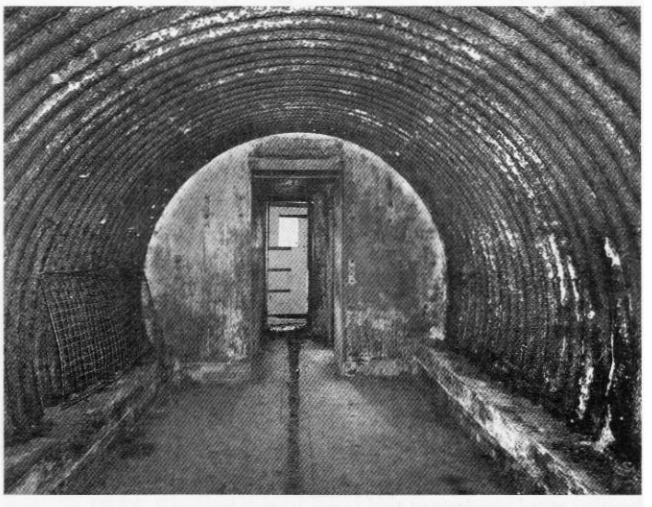
Coleshill Uncovered

The Coleshill Uncovered project was created in May 2010 by the Coleshill Auxiliary Research Team (CART) who wished to conduct a full survey of the grounds as part of their ongoing research into the training of Winston Churchill's secret Auxiliary Units. The main participant groups and stakeholders in the project include:

- Coleshill Auxiliary Research Team (CART)
- Subterranea Britannica (SB)
- The Ridgeway Military and Aviation Research Group (RMARG)
- Great War Archaeology Group (GWAG)
- University of Bristol (UoB)
- The National Trust (NT)



Sub Brit's Linda Bartlett, Alex Horsfall-Turner and Martin Dixon at Coleshill. Photo from CART



The operational base at Coleshill House.
Photo by Nick Catford

Archaeological work on 22 and 23 January, 2011

It was a chilly January morning when about 25 people, including eight Sub Brit members, congregated in the car

Air-conditioning plant room at Bempton rotor radar station in 1998. Photo Nick Catford

The north tunnel seen from the causeway across the water cistern beneath Coleshill House. The north tunnel was originally intended to bring water in to the cistern. Photo Nick Catford

The Entrance tunnel to the Eagle's Nest ('Hitler's tea room') high in the mountains above Berchtesgaden in Bavaria, Germany. The 406-foot long tunnel leads to a brass-lined lift rising 390 feet to the Eagle's Nest. Photo Tim Robinson

The two winch shafts to the Great Northern warehouse above are seen standing (1994) in the middle of the dry canal bed of the Manchester & Salford Junction Canal. Photo Nick Catford

Underground Olive Press in Gallipoli, Italy

Standedge canal tunnel

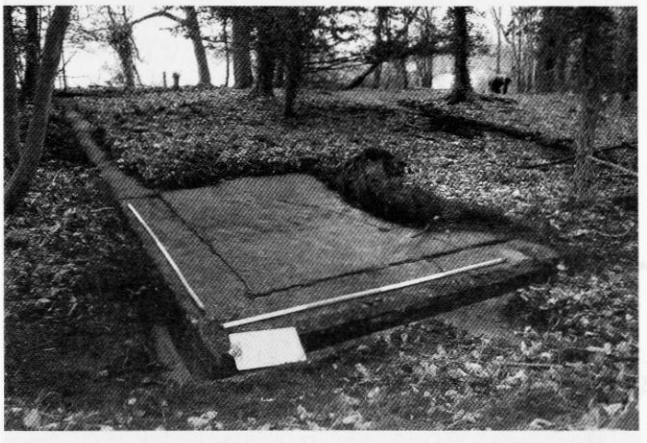
The disused public toilets located in the 1839 Victoria Arches in Manchester. The toilets closed in 1967. Photo Clive Penfold

Copper staining in Wood Mine in Alderley Edge, Cheshire. Weathering of copper-bearing minerals produces a wide halo of staining (called a gossan) by secondary copper minerals – often blue-green malachite as in this rock. The presence of such copper staining is a useful exploration tool, but the presence of economic amounts of ore can only be tested by drilling down into unweathered rock. Photo Clive Penfold

park at the National Trust estate office at Coleshill. The complete team included members from all the main stakeholders in the project. This was the first weekend that we had been authorised to undertake initial exploratory works to try to understand more about Coleshill's past, focusing on the known World War II Auxiliary Units training site.

On our way to the briefing we passed the lodge house and the hefty back gates to the estate which have 'Coalbrookdale' emblazoned across the posts, indicating the Shropshire pedigree of the high-quality ironwork. We also had a look at the Estate's stable yard area where various administrative and office functions took place during WWII.

Metal detectors, shovels, spades, brushes and a collection of other archaeological equipment were carried. After discussion we were split into teams to begin working. Whilst a walking survey took place and the metal detectorists were focusing on the northern end of the site around the OB area, other teams set to work in the area where buildings once stood before being demolished after the war. The buildings in question were believed to be medium- and large-scale Nissen huts formed of semi-cylindrical corrugated steel roofs with end walls.



One of the Nissen hut bases uncovered in January 2011. Photo from CART

The functions of the huts on the Coleshill site are speculated to have had various purposes associated with training, but also some manufacturing function, including a possible clandestine radio factory. In any case the first step was 'surface clearance' by ridding the flat concrete foundation bases of as much as possible of the layers of leaf mulch, soil and roots that had accumulated over the intervening decades.

This was harder than it sounds, even with shovels, picks, buckets and spades! In some places we were lucky enough to be able to roll the earth cover up like a carpet, but even that was heavy going. At the end of the clearance we had exposed and measured the original concrete bases complete with level changes, drainage gulleys and post holes.

The weekend's work was non-invasive, except for this 'surface clearance' over hard structures where clearance of up to 20cm in depth was approved. As well as hut bases, concrete structures include a vehicle ramp and what was originally believed to be a 'generator plinth' but that appears to have been an incorrect assumption. Unfortunately, however, the true function remains a bit of a mystery for now. The hut bases located and partially cleared include at least two which were previously unknown. The true extent of the supposed clandestine radio factory hut was uncovered too.

Artefacts uncovered

Archaeological finds during the day across the site included a number of metal items which were bagged up and labelled. Here are some of the items found:

- Bayonet in excellent condition with intact leather sheath
- Live mortar (see below)
- Other ammunition remains
- Radio parts
- Chains
- Pipes
- Screw pickets
- Cables
- Corrugated iron and guttering
- Other metal finds

Whilst the work was taking place over the weekend team members worked together to report on the site and sketch the features exposed. We were able to write up detailed field descriptions based on our observations and measurements. This all contributed to the first Coleshill survey report and was backed up by some great photography from several individuals.

Sub Brit's Adrian Armishaw using a deep scanner to try to locate a second OB. Photo from CART

Adrian Armishaw's deep-level metal detector, a White's TM808 model, was deemed to be very successful and identified some interesting large signals for later investigation. Perhaps he has located another OB? Time will tell. Meanwhile a BBC news crew were wandering round interviewing and generally having a look at what was going on, before publishing the story on the local television news that weekend. I promise that no posing was involved and all the filming was spontaneous including an excellent shot of my Sub Brit Hi-Vis tabard!

The live mortar was uncovered a few metres away from the currently viewable OB, and had to be detonated by the army before we started work on the Sunday! Strangely though, before the mortar was made safe, people continued gathering round in curiosity knowing full well what it was!

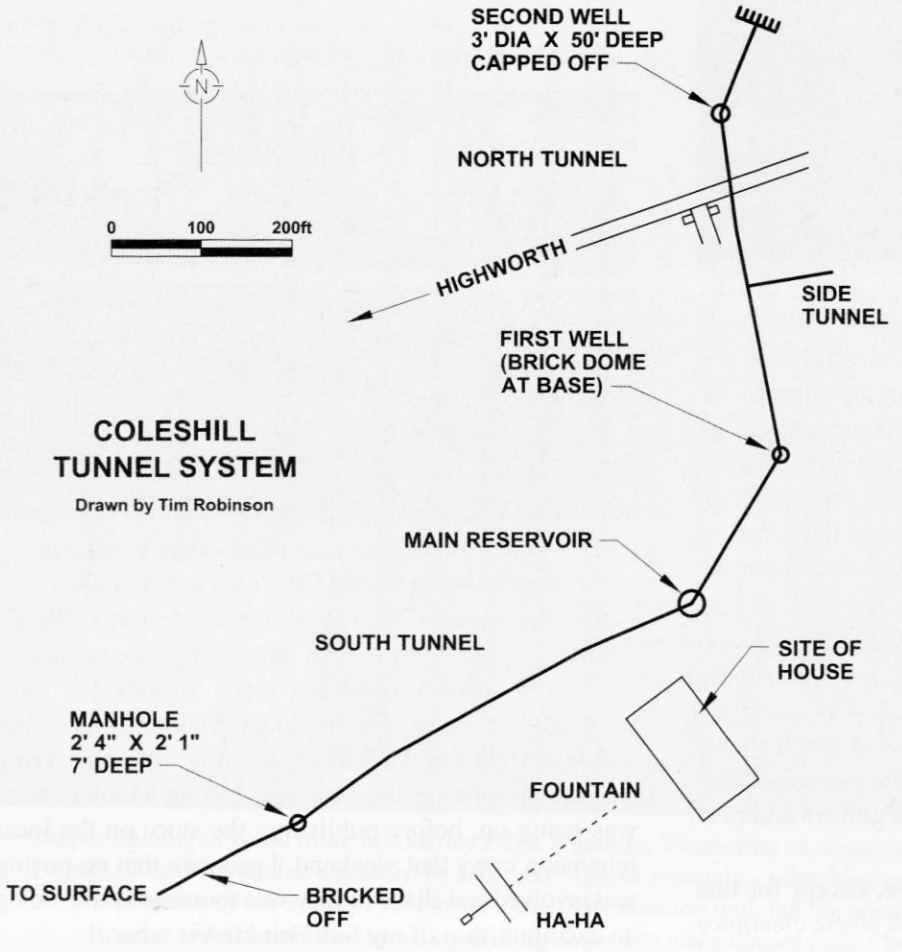
The live mortar shortly before it was blown up by the army. Photo from CART

We were also offered the opportunity to have a look round the existing OB on the site which was a really good preview of what we hope to find in the future. By the end of the Saturday everyone was exhausted so the Sub Brit team and others gathered for a pint at the nearby *Radnor Arms*. On Sunday the pace of work was a little gentler with team members slowly peeling away as the day progressed and the bagging, surveying and recording drew to a natural close by the late afternoon.

Coleshill Underground

Although the remains of Coleshill House were demolished after the fire in 1952, there are still some fascinating underground remains that predate the Auxiliary Unit period by over two hundred years. Working with CART and the National Trust, Subterranea Britannica led an investigation and recording of these structures in June 2011. CART established a good deal of background information from desktop research prior to our accessing these underground areas, which include both the former cellars of the house and the water tunnels.

In 1980–81 members of Highworth Historical Society, 'properly equipped' with ropes, ladders, and miner's helmets, had descended the tunnels and made approximate measurements with 50ft tape and compass. The tunnels were found to be as described by Sir Mark Pleydell (see panel) and were still in good condition. The mortar was hard and there were very few cracks. Various other observations and measurements were taken regarding the water supply and tunnels. Additionally a transcript of a taped interview with Derek Pedley (who grew up around the estate as the son of the caretaker who arrived in 1946) had allowed us to glean some anecdotal evidence about what to expect underground.



Further work in June 2011

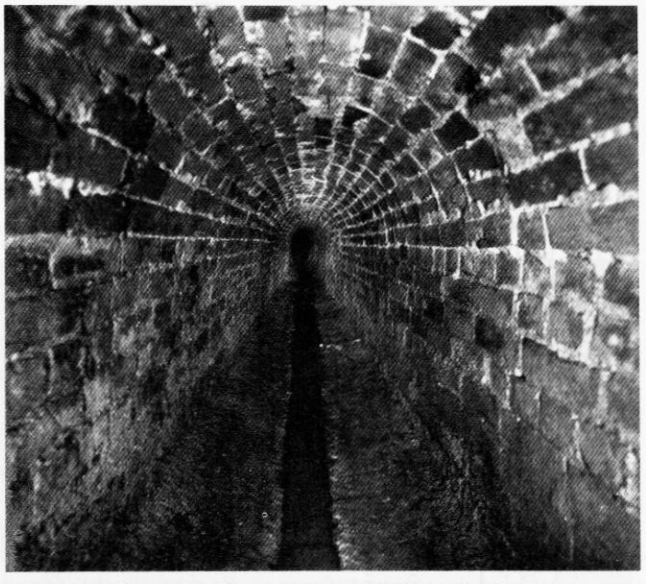
On Saturday 4 June a small group of eight Sub Brit members was authorised by the National Trust to carry out a 'Maintenance Inspection' of the remains of the underground features on the Coleshill Estate. These features are made up of the cellar areas from the demolished house, in addition to a 'water mine' comprising a small underground reservoir and a set of two deep-level tunnels designed to collect water from surrounding underground springs and channel it into the main cistern for the use of the house and estate. These tunnels are truly extraordinary feats of engineering for constructions dating from the early eighteenth century. The second of the two – the south tunnel – is designed as an overflow to carry away excess water when the flow from the north tunnel is too excessive to be contained within the reservoir of the cistern chamber.

From *The Travels Through England of Dr Richard Pococke*
ed. by James Joel Cartwright, 1879, vol. II.

"From this place I went 3 miles to Coleshill where S[r] Mark Pleydell has an exceedingly well built house of hewn freestone brought from Barrington, nr Burford.

There is a wilderness garden behind the house. But the great curiosity of the place is the water, which S[r] Mark has brought to this house, and the garden. There was a well on the side of the hill, 63 feet above the basin in the garden, from which the water being drawn up was conveyed by pipes to the house; but the pipes being out of order, he thought of bringing it underground from the bottom of the well, higher up the hill, and arched it from the level of the bottom of the well; here it is 70 ft below the surface. He then carried the canal underground to the road and under some offices, about half a furlong, springs rising plentifully for 40 yards below the well; it then made a turn down the yard for ° a furlong more; here another well was dug down in order to bring up the earth; it was then carried into the garden, where they opened a trench and carried it about 100 yds in the same direction, and then making a turn brought it to the basin, and arching the whole over with bricks this part was covered over; they reckoned the whole about 2 furlongs. From the basin it is carried back under ground and passes down a wall on 2 sides of a garden, from which it falls down through stone pipes into little basins, and forms another basin in a garden below. This underground work is exactly like that mentioned between Damascus and Palmyra in the *Description of the East* [this was Pococke's own book], and as it was done about 8 years ago it is probable that he took his hint from that."

Richard Pococke, 1757.



The north tunnel. Photo by Nick Catford

The exercise had two main aims. CART wanted to establish whether or not there was any evidence of wartime usage of the cellars relating to the Auxiliary Units for their project, and Sub Brit intended to carry out a tunnel inspection to use as the basis of a brief report for the landowners, the National Trust.

Health & Safety

Hurdle number one was the Confined Spaces Regulations Act 1997 which currently governs work within any space that might be considered confined. It says that confined spaces should be avoided, but if you must enter them, you must be aware of all potential issues such as ventilation, have safe systems of work in place, good lines of communication, and have emergency procedures in place. For the most part it is all common sense. There is a grey area about how the regulations apply since technically we were not 'working' as such, and the rules are meant to apply to company employees. But still, it's better to be safe than sorry and to keep the National Trust as much on-side as possible.

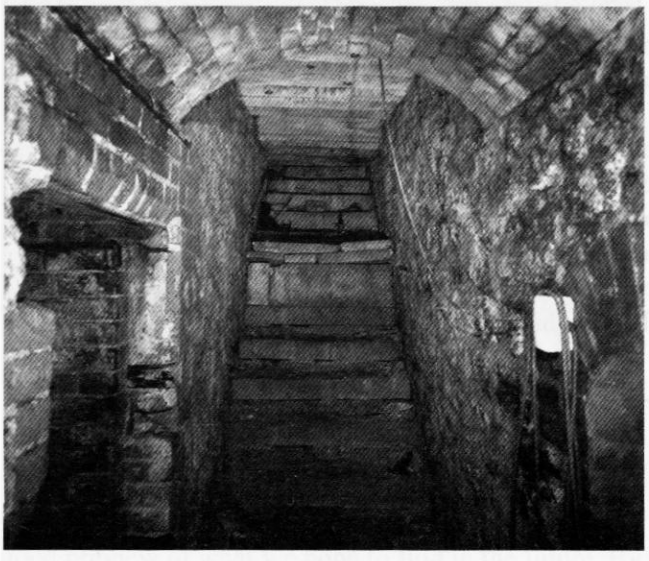
I'm sure many Sub Brit members are familiar with the legislation, but when it comes to undertaking any kind of site visit or investigation it can be the proverbial 'spanner in the works' which will give the powers that be a justifiable excuse to prevent access. That is of course unless a risk assessment has been completed, a health and safety briefing carried out, disclaimers completed and all the correct insurances are in place. Thanks to the Health & Safety Executive it is much harder to visit sites these days, unless all the I's have been dotted and the T's crossed. The corresponding upside is of course that fewer people die or get injured.

In terms of Risk Assessment we basically had to identify all the risks, both general and site specific, and then find ways to mitigate or reduce them to prevent accidents and mishaps from taking place. The areas covered were (in no particular order):

- Light levels
- Uneven floors / obstacles
- Constrained entrance / exits
- Headroom
- Structural Stability
- Heights & Ladders
- Air, Ventilation & Dust – including gas testing
- Asbestos (the dreaded 'A' word)
- Water – depth and pathogens / toxins
- Wildlife
- Fire & heat
- PPE
- Teamwork

Going Underground

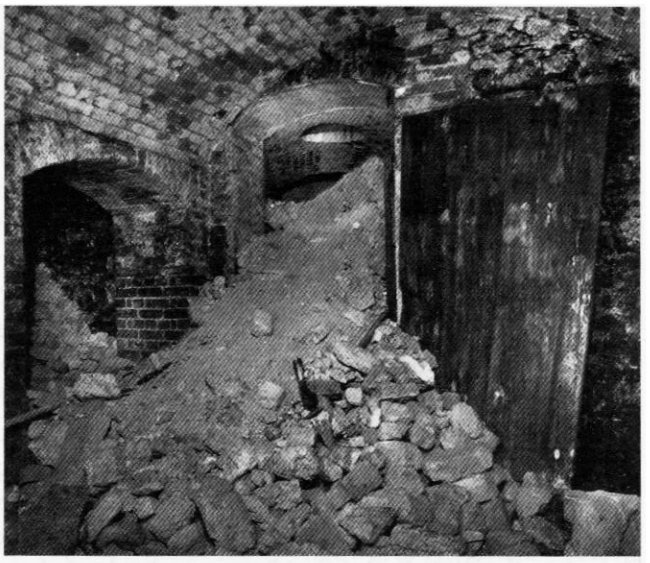
A rather unassuming manhole cover, in what is a current tenant's garden, was the starting point for the day's activities. Apparently the manhole was meant to be locked when we arrived and so we had been armed with the appropriate key by the National Trust. It turned out that the manhole cover was not only unlocked but also not even lockable, which left us with a key for which nobody seemed to know the location of the relevant lock. Another mystery as yet unsolved.



The original steps down to the cellar are located beneath the manhole cover. Photo Nick Catford

Once we had set up the equipment, a gazebo and an entry ladder, and following a safety briefing, Nick Catford proceeded downwards with a gas detector and a respirator on standby in order to carry out a pre-inspection gas check. When the gas alarm went off we were slightly concerned, only to be reassured that it was just a breath test to check the oxygen-content sensor was working. In fact all the locations where the gas detector was taken were completely clear of any issues, with very fresh air in most areas. This leads us to believe that there is a free flow of air through one or more of the access points even with manholes and brick or concrete caps in place.

Once we had access ladders set up to allow easy access into the entry passage, cellars and the top of the cistern area, the CART team got busy performing a detailed, measured survey of the cellars, all the time looking for evidence of WWII use.

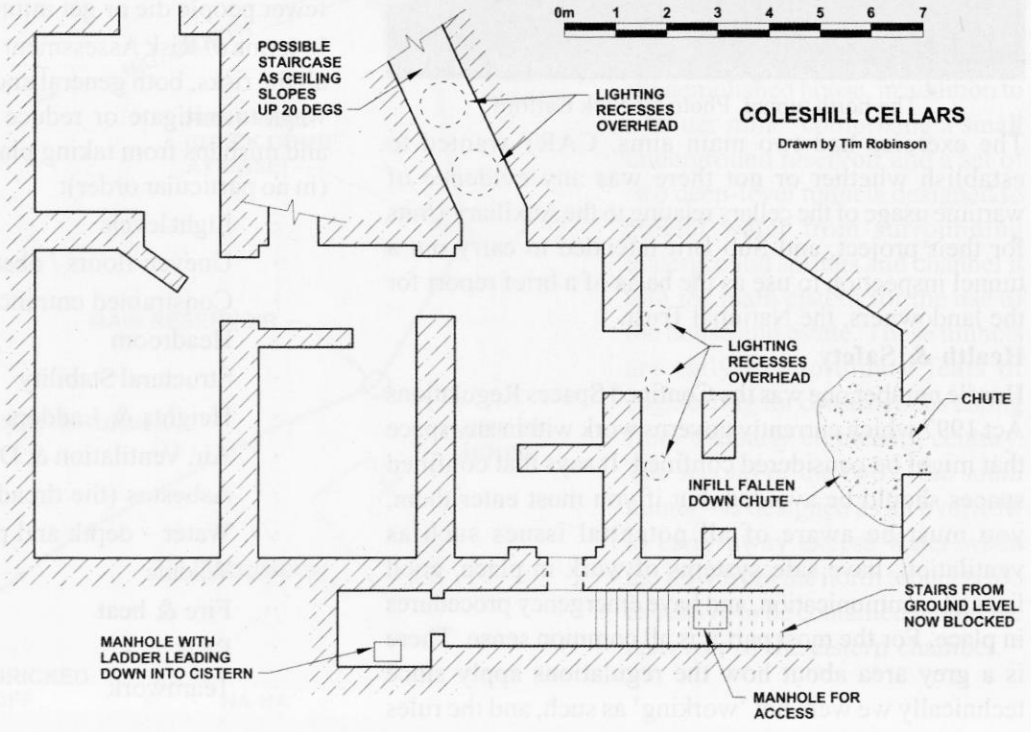


This door led up into Coleshill House, a lighting aperture can be seen in the ceiling through the doorway. The backfill is from the demolished house above.

Photo Nick Catford

The extant house cellar area appears to be the original coal storage areas for the house. There are several examples of light apertures from surface level and one example of a coal chute from surface level too. An inclined passageway leading to the surface but now blocked by backfill was noted on the southwestern side of the cellars. There are quantities of coal dust and dark markings indicative of the presence of coal over several of the walls throughout the cellars. The walls are of brickwork and occasionally stone construction and show almost no evidence of water ingress or general structural deterioration.

Openings to other areas and the surface are generally filled with piled rubble and detritus from the time the


0m 1 2 3 4 5 6 7
POSSIBLE STAIRCASE AS CEILING SLOPES UP 20 DEGS
LIGHTING RECESSES OVERHEAD
COLESHILL CELLARS
Drawn by Tim Robinson
LIGHTING RECESSES OVERHEAD
CHUTE
INFILL FALLEN DOWN CHUTE
STAIRS FROM GROUND LEVEL NOW BLOCKED
MANHOLE WITH LADDER LEADING DOWN INTO CISTERN
MANHOLE FOR ACCESS

house was demolished, including bricks and soil. The ceilings tend to be arched brickwork, again with minimal deterioration. The new manhole and the chute areas have a reinforced concrete slab covering, probably added at the time of demolition to reduce the need to infill the cellars before reinstating the ground level above. The light apertures appear to be fairly well capped from above, however there is some glass still evident at the top of one of them. Within the cellars are piles of empty drinks bottles which date from between 1960 and 1975, confirmed by the current tenants to have been stored there by their parents. Structurally the cellars appear to be in reasonably good condition aside from one or two areas where infill may locally be supporting deliberate breaches in the arched ceiling; however we didn't undertake any invasive investigation to confirm this.

Cistern and tunnels

As Sub Britters we were of course a little more adventurous and so investigated the water mine as our priority, beginning with the top of the access down into the main cistern. To our surprise there was not only a modern anchored aluminium ladder in place, but also evidence of a relatively recently installed (ten or so years ago) electrically powered water pump with associated accumulator vessel and lengths of blue piping meandering up into the garden area. Apparently this pumping system used to be used as a water source for the current tenant's garden but is now out of use.

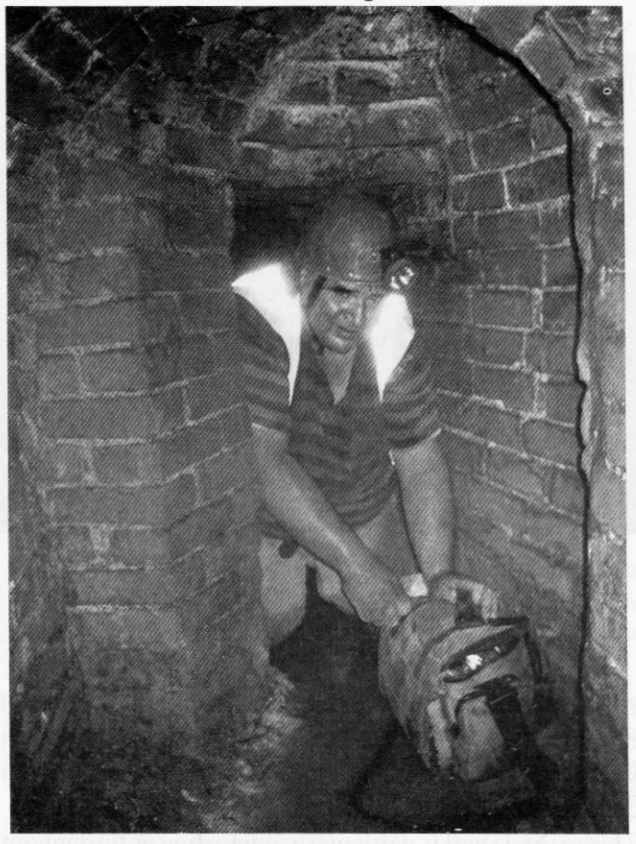
The access ladder resting on the narrow brick causeway across the cistern. The south tunnel is seen behind the ladder. Photo Nick Catford

The main cistern area is reached via a ladder down from a subterranean chamber at a level slightly above the level of the cellar floors. The access chamber is partially floored and there is a large opening into the cistern area. The ceiling to the access chamber has a brick arch construction which appeared to be in good condition. The cistern has a vaulted brickwork ceiling for about two thirds of its size; the remaining third is taken up by the short, wide vertical shaft to the access chamber. The brickwork forming the vaulted roof (floor to the access chamber) appeared to be in good condition. A large number of bottles (similar age to those in cellar) were noted stacked to the right (west) of the opening.

The access ladder led down to a narrow brick causeway within the main cistern chamber. The cistern is approximately 3.5m in diameter with a 0.26m brick walkway around the edge. The brick causeway stretches across the cistern and is formed from two arches reaching down to the base of a reservoir and is about 0.45m wide. The reservoir currently has a water depth of approximately 1.9 to 2.0m.

There are two tunnels from the cistern, each running off from one end of the brick causeway. As previously mentioned, the north tunnel was originally intended to bring water in to the cistern and the south tunnel was intended to drain off excess water from the cistern. An approximately 15cm diameter iron pipe joins the north and south tunnels just above water level on the west side of the causeway and apparently provides flow continuity between the two tunnels.

When we had taken in the sights of the cistern chamber the more adventurous of us split into two teams in order to explore and record the extremely confined spaces of both the north and south tunnels. Martin Dixon and Graham Garrard took the south tunnel and Nick Catford and I took the north tunnel to begin with.



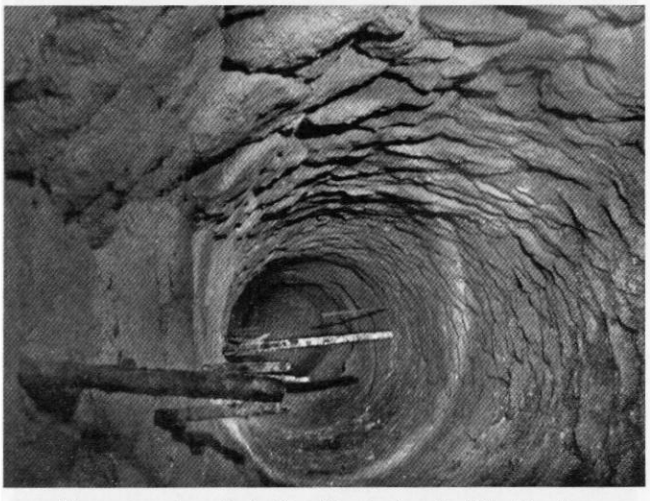
Nick Catford negotiating one of the tight corners in the north tunnel. Photo by Alex Horsfall-Turner

At one point during our visit, an interesting few minutes were spent when we were unable to hear voices from the south tunnel, it having a much more a deadening effect on voice transmission than the north equivalent. Luckily this didn't last for too long and Martin and Graham were back in touch before we had reached the point of calling the emergency services or local cave rescue team! After a lunch break, John Winterburn and I went back down the north tunnel to finish the investigation that Nick and I had started earlier.

North Tunnel

The north tunnel was measured at 166 metres in length from its portal in the cistern chamber. This tunnel is composed of several lengths with direction changes and wells, or former shafts, along its length. There are also two side tunnels, the first being to the right-hand side at 94m along the main tunnel with a length of approximately 25m, the second being to the left-hand side at 147m along the main tunnel with a length of approximately 7m. The tunnel dimensions vary along the length between heights of 1m and 1.84m, and between widths of 0.7m and 0.8m.

The tunnel construction is generally of brickwork sides with a semi-circular arched brickwork ceiling along with a floor-level water channel to bring water to the cistern. The floor channel is formed between flat, tightly fitted brickwork benching and there are occasional side channels to allow water to collect. There are also occasional (presumed) candle holes in the walls of the tunnel. The first clear corner in the tunnel is located at 45m along at the base of a well which has been capped off at the level of the tunnels with a small area of brick vaulting.



The second well shaft with steel rods fitted by the Auxiliers during WW2 to allow them to descend the well and access the tunnels during training.
Photo by Alex Horsfall-Turner

A second well/shaft occurs at 142 metres and mud obscures the base of the tunnel from here onwards – it wasn't possible to determine if the floor channel continued; mud also covers the floor of the side tunnels. This second shaft is particularly interesting as throughout its 14 metres are steel rods – apparently dating from WWII – installed as rungs to allow ascent. The top of the shaft thus connects with an Auxiliary Unit Observation Post (OP) but it was not possible to rig ladders to allow safe ascent and full investigation of this feature.

Mortar condition, although uneven as expected in service tunnels, is generally solid. There are one or two areas where the keystone bricks are showing degradation and friability at the face, but this does not appear to be a structural issue. The brickwork is generally in reasonable condition. Historic graffiti is evident at the junction of the first tunnel in large quantities (94m along) and also to a lesser extent at both the junction with the vertical shaft at 142m and the junction with the second side tunnel at 147m. The scrawled moniker of Derek Pedley dated 1952 was noted along with many other examples of what were suspected as soldiers, village children, even former dinner guests at Coleshill dating all the way back to the eighteenth and nineteenth centuries and right up until the later part of the last century.

South Tunnel

The south tunnel was measured at 140.6m in length from its portal in the cistern chamber. This tunnel is generally straight apart from a slight turn to the west at 30.7m from the cistern portal and a pronounced kink to the east between 77.3 and 80.2m from the portal. At the start of the kink (77.3m) there is a marked joint in the brickwork suggestive of a join in the tunnel lining.

The dimensions of the tunnel decrease in four increments from approximately 1.0m high x 0.7m wide at the cistern portal to a snug 0.5m x 0.7m at its far end (140.6m from the portal). The end of the tunnel is of brick construction, but includes an approximately 0.25m circular opening that presumably provides drainage continuity to the surface. There are no side tunnels, but an access shaft is located on the east side of the tunnel at 110.6m. The final thirty metres are too tight to turn round in so a backward crawl was necessary on the return journey.

The south tunnel appears to be constructed in a far more uniform manner generally, also with brickwork sides and a semi-circular arched brickwork ceiling. At floor level there is a central water channel which is constructed with angled brickwork benching with standard-sized bricks, in contrast to the more level benching in the north tunnel. The channel was partly filled with water to a distance of 47.2m from the portal at the time of inspection. However, the presence of limescale and crystals of calcite (calcium carbonate) formed from evaporation of water along the full length of the tunnel is evidence that at periods of high rainfall water has historically flowed along the full length of the tunnel.

Between approximately 30m and 60m from the portal, the brickwork benching, particularly on the west side, has moved and appears to be splitting from the wall. The side wall and ceiling arch are in good condition and show no cracking. This suggests that settlement of the tunnel is unlikely to be the reason for the damage. It is suspected that the movement

may be at the capillary fringe where overflow water seeps into the surrounding ground and may be related to calcite precipitation in the mortar between the brick and excavated rock floor. This is believed to have resulted in the lifting and movement of the benched brickwork. Tree roots were also noted within the section which may also be a contributory factor; they have certainly exploited the cracks. In structural terms the damage is cosmetic and is considered to be of limited significance.

Brickwork in good condition

No side channels or soakaways were noted. Between 5.6m and 72.1m from the portal entrance are a series of small approximately rectangular or arch-shaped openings which appear to have been constructed to hold candles (these features are surprisingly referred to as channels in the 1980-81 survey). These candle or lamp recesses are typically located approximately 0.25m above the floor and are approximately 0.23m high by 0.15m wide by 0.2m deep. In several of the candle recesses, the edges of the bricks have been chamfered to give the arch shape.

A number of these candle recesses have brick or tile backs, while some have no backs. Those without backs provide an opportunity to inspect the rock behind the tunnel lining. The rock appears to be pale greenish-grey weathered clayey sandstone which shows numerous original pick marks in a few locations. Towards the cistern the material appears more clayey, but is less well observed.

An access shaft is located 110m from the portal entrance. This 0.9m deep by 0.8m feature lies immediately to the east of the tunnel and has been capped at a level of approximately 1.85m above floor level. The brickwork for the shaft and capping slabs appears in good order and shows no evidence of distress. Mortar condition throughout the tunnel, although uneven, is generally solid; brickwork is in reasonable to good condition.

The change in character of the tunnel section, presence of a distinctive joint in the brickwork, notable kink between 77.2m and 80.2m, the existence of an access shaft at 110m and presence of candle holders over a limited section of the tunnel suggest that the tunnel may have been constructed simultaneously from two or three points. It seems likely that the far end of the tunnel may have been excavated as a cut and cover structure from 140.6m to the shaft at 110m as no 'candle recesses' occur during this section. From the shaft the tunnel appears to have been progressed northwards from 110m to 80.2m and the orientation then adjusted to intercept a second tunnel driven south from the cistern portal to 77.3m.

The large amount of material removed to form the cistern, the north tunnel and the first part of the south tunnel would suggest that much of the material may have been removed from a large-diameter open shaft now occupied by the cistern and access chamber, and that the access chamber roof may have been constructed on completion of the works and backfilled to the surface. Generally the cellars and water tunnels appear to be in a satisfactory condition at present with no major maintenance needs identified for the National Trust to be concerned about. The mortar appears to be generally hard and not particularly friable.

During the 1980/81 inspection it was noted that water was still running from the north tunnel into the cistern. It was also stated the water was crystal-clear and tasted good. In contrast the water flow appears to be quite low at present, the water appears grimy on the surface of the cistern reservoir (believed to be calcite precipitation from evaporation at the water surface) and there are calcite deposits evident along the surfaces of water channels in the tunnels. This could indicate a reduced water flow, possibly as a result of modern water extraction in the area impacting upon the local water table, or silting-up of the fractures feeding groundwater into the collection tunnels.

What's Next?

At the time of writing, as email list subscribers will be aware, a second week of archaeological work has been planned at the Coleshill Estate for five days commencing Sunday 3 July.

The week will involve a much greater degree of investigative work, expanding on the initial weekend in January. The plan is to excavate several trenches in areas of interest, such as the generator plinth – which is now believed to have a different but as yet unknown function – and also where some of the strongest deep-level metal detector results were being obtained. The hope is to discover and excavate another OB on the site. Watch this space!

Recommended Reading / Viewing

Wikipedia article on the Auxiliary Units:
http://en.wikipedia.org/wiki/Auxiliary_Units
Pleydell-Bouverie family
http://en.wikipedia.org/wiki/Earl_of_Radnor
Main Coleshill website:
http://www.coleshillhouse.com/coleshilluncovered/
Videos from January:
www.coleshillhouse.com/coleshilluncovered/press-from-coleshill-uncovered.php
BBC News website:
www.bbc.co.uk/news/uk-england-wiltshire-12261855
Stewart Angell's Book:
The Secret Sussex Resistance
www.amazon.co.uk/Secret-Sussex-Resistance-1940-44-Military/dp/1873793820/

Acknowledgments

My thanks to Tom Sykes, Nick Catford, Graham Garrard, John Winterburn, Bill Ashby, Adrian Armishaw, Stewart Angell, Martin Dixon and Linda Bartlett for source material, expertise, hard graft and general help!

[Editor's note: As this edition of Subterranea went to press, the results of a second week's archaeology at Coleshill were emerging. A number of Sub Brit Members were on the team and finds included what appear to be the entrances to two further Operational Bases. Check the Coleshill website for latest news.]

Ten days in Lecce, southern Italy

By Andrew Catford

In early June, I took my wife for a break in Lecce province at the heel of Italy's boot to give her the required time in the sun to keep a happy home. I'd like to share with you a few lines from my diary of the holiday . . .

Ten days on the beach may seem like heaven to some but it's not my choice – there must be something to do underground around here to keep the balance fair.

A quick glance through the hotel guidebook and three opportunities appear – the immense cave system at Castellana 200km to the north; sea caves accessible by boat at Santa Maria di Leuca, the very southern tip where the Adriatic meets the Ionian sea; and an unexpected note saying "come to Gallipoli (no, not that one – the Italian coastal town) to see cathedrals, museums and underground oil."

Wednesday afternoon, and if we're going to go for a drive, why not head south. Before you know it, we're on the cliff top overlooking the bay of Santa Maria. We walk out over the headland and there, in front of us, is a waist-high circular wooden fence surrounding a rocky depression set back 100m from the cliff edge. I've always considered mysterious fences harder to resist than chocolate, so despite the threats and protestations from my wife, over the fence and down I go.

In the past sea caves have often proven a disappointment, with many a promising entrance petering out after a few metres. This was not the case today. The sound of the waves was quickly obvious and the water soon came into sight

Clambering down over the rocks I was quickly able to reach the sea and paddle round the boulders to get a good view of the surrounding cliffs.

Guilt eventually got the better of me and I climbed back up the slope just in time to avoid a school party on their way down.

Finally, an unexpected treat to finish the visit – the headland above the cave was home to the remnants of a gun emplacement adjacent to a concrete buttress housing a metal grille door. This being Italy – just a catch and no padlock! The steps led down to a small magazine with no particular endearing features but just being able to gain access made it all worthwhile!

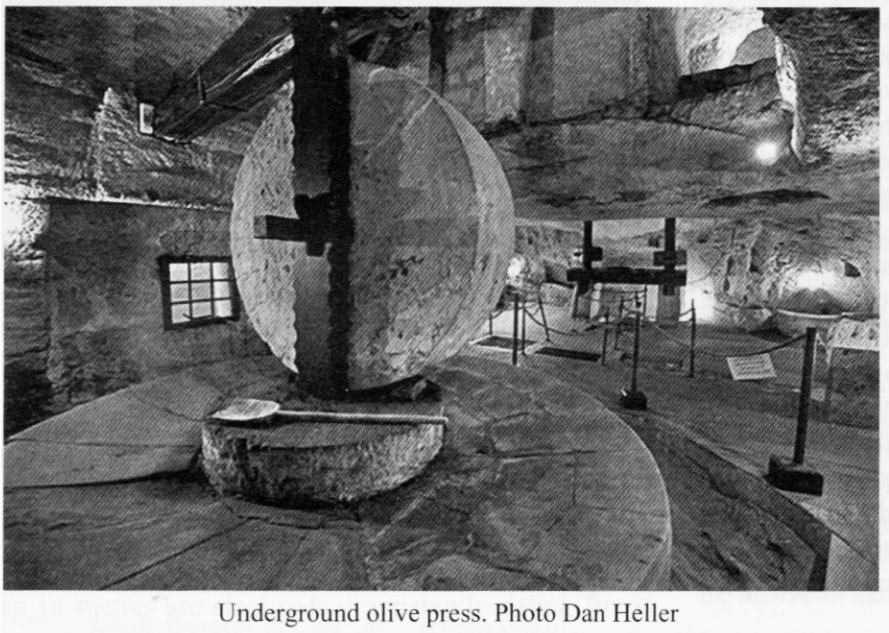
Thursday, and Gallipoli was on the menu. Now fridge magnets and biscuits aren't really my cup of tea but hey-ho, the prospect of underground oil made the trip conceptually well worthwhile. After all, I'd not long returned from the Sub-Brit trip to Sweden in May and I knew all about underground oil from a visit to the vast Oxelösund storage facility that we visited near Stockholm.

The old town of Gallipoli is an typical quaint old Italian fishing community – obvious signs of opulence in days gone by, but now looking decidedly down at heel as soon as you step away from the main shopping street leading up to the cathedral. There were more churches than you could sensibly require and a restaurant through every other archway.

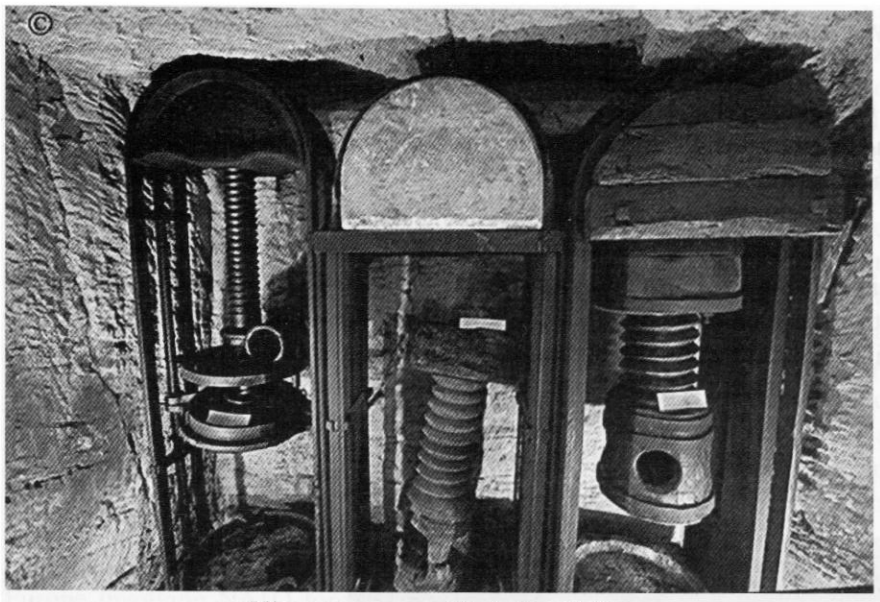
Despite having trawled the internet the previous evening, I saw no sign of an oil storage facility – then hey, look down there. Peering by chance through a grille at the side of the pavement I spot a dim electric light shining up from much too deep to ignore. A nondescript door set into the adjacent wall led down a twisting flight of stone steps into a man-made chamber well below the shops above. An enthusiastic local pointed out excitedly that I had inadvertently missed the booth where a ticket lady was talking in an animated fashion to the mobile phone she'd chosen in place of the ticket machine.

Parted from my €1.50, I carried on down into the sizeable multi-roomed chamber which housed the remains of a set of three olive presses set over accompanying wells for the transfer and storage of olive oil. Not what I have anticipated, but well worth the trip and cheap at the price. The enthusiastic guide gave a 15-minute synopsis of the history of the site.

Unfortunately my Italian is pretty basic, having progressed not much further than *grazie*, *prego* and *vino rosso*! I did soon pick up on the access hole through which olives were dropped by local farmers and the process by which the olives were held and pressed using an animal-powered treadmill. Small windows led to cells which may or may not have been used by the military at some point and there was definitely a mention of tuberculosis at one stage – but I'm not sure of the context.



Underground olive press. Photo Dan Heller



Olive press screws. Photo Dan Heller

Once the guide had finished and the crowd had asked the appropriate questions, we were free to poke around and photograph at will; this was most enjoyable, especially after a quick inspection revealed a similar adjacent chamber housing the remains of a further three presses. All in all a very entertaining forty minutes and worth the battle with the unauthorised traffic control officer who tries to tell you were he wants you to park and then charges you a euro for your compliance.

Friday arrived with the crowning glory of my underground visits. The trip to Castellana took two hours but driving through the lovely Italian countryside brought back the joy of motoring.

There are two guided trips on offer but having made the drive, the full two-hour, 3km version was the only one to join. Sadly I'd misinterpreted the timetable and my impression of hourly trips with English speaking-guides was inaccurate – there were only two trips a day and as I'd missed the first by thirty minutes, I had to wait another 2 ˚ hours for the final trip of the day. Fortunately, there was a pleasant picnic area and a well-presented display in the adjacent museum giving a mass of information for those interested in the history and geology of the system.

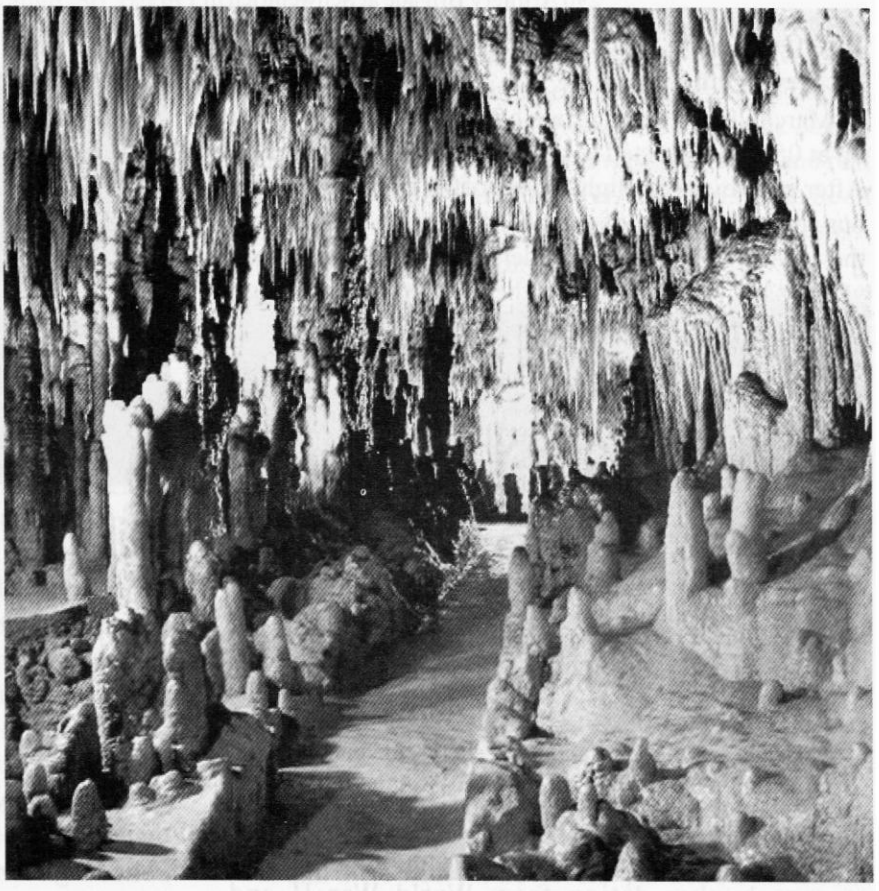
When the allotted time arrived, I was surprised to find our party consisted of just seven visitors – three English and four German. The guide was eloquent and enthusiastic and her well-practised patter gave an interesting and comprehensive description of the system.

Despite the normal "Health and Safety" restrictions imposed in show caves and a local government-imposed restriction on photography after the first massive chamber, the visit was well worth the effort. We started by going down sixty metres of stairs into "La Grave", the first and largest of a series of cave chambers. "La Grave" is 100m long and 50m wide with natural light falling through a collapse in the centre of the roof.

The huge cavern had long been used by locals as a dump for the pulp of pressed olives commonly grown in the region. When first properly explored in 1938, local speleologist Franco Anelli, brought in by the local tourist board, found a twenty metre-thick layer of pulp covering the floor of the chamber.

We then passed through a series of five more chambers, each containing splendid rock formations creatively named by the operators. These were followed by a long narrow section known as "The Desert" due to the sparsity of formations, but the walk was rewarded by some more spectacular stalactite formations in the final smaller chambers culminating in "The White Cave", which is simply stunning.

Southeast Italy offers a holiday for all – I can highly recommend a visit.



Formations at Castellana

A weekend in Wittstock, Germany

Background

The Soviet forces in East Germany – Group of Soviet Forces, Germany (GSFG), later Western Group of Forces (WGF) – comprised five land armies and one air army - NATO equivalent: tactical air force (TAF). The northernmost land army was 2 Guards Tank Army, headquartered at Fürstenberg. Each army had its own artillery brigade to provide conventional and nuclear fire support. In the case of '2 Guards', as it was conveniently called, this was the 290th artillery brigade based at the extensive Schweinrich training area a few kilometres to the east of Wittstock.

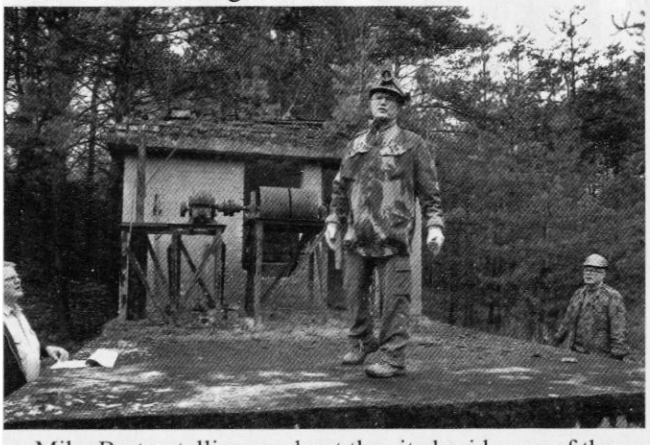
The brigade had two gun battalions equipped with 152 mm self-propelled guns and two howitzer battalions equipped with 152 mm gun-howitzers (D-20), with each battalion having some 24 'tubes', i.e. guns, thus providing a total of 96 tubes – a formidable fire power. All units were stationed in Schweinrich.

290 Artillery Brigade at Schweinrich in 1987

Day One

by Steve Underwood

In March 2011 a small group of Sub Brit members met up at 05.00 at Stansted to take the early flight to Berlin. After an uneventful flight we set off in two hire cars for our first destination of the two-day trip, a bunker near the town of Schweinrich. There we met Mike Barton who was to be our guide for the weekend.



Mike Barton telling us about the site beside one of the ammunitions lifts that were our access point into the munitions bunker. Photo Steve Underwood

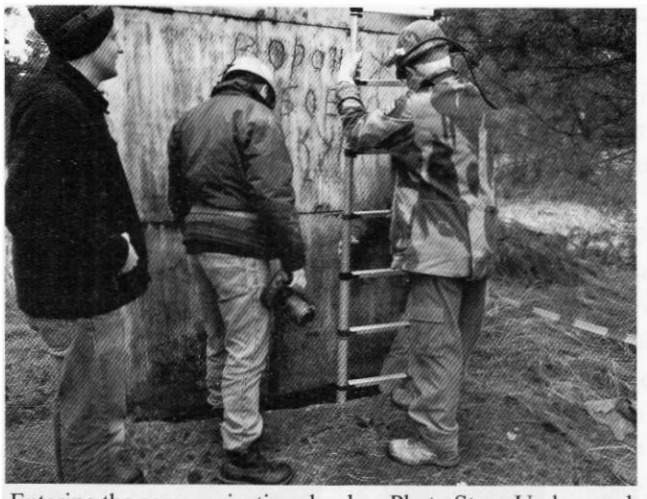
Our first visit was a large underground munitions or storage bunker dating from World War II and subsequently used by the Soviets. Entry for us was by clambering onto a loading platform and going underground alongside the ammunition lift mechanism that is still in place. This led into a wide corridor at the bottom that went round a large central storage area. The main storage room was empty, but still had a few electrical fittings such as switches and lighting units, the roof being supported by a series of concrete columns. There was other electrical switchgear still in place around the bunker, together with further ammunition lifts which unusually had not been scavenged by scrap dealers.

The huge underground munitions storage area. Photo Steve Underwood

The 'Bombodrom'

After sufficient time to take photographs and have a good look round we moved off to an abandoned Soviet communication bunker named 'Kulon'. This is located on the southern edge of a vast area of heathland previously occupied by the Soviet Army after WWII for training and part of it by their airforce as a bombing range, hence the local name 'Bombodrom'.

Following reunification of East and West Germany the Government stated they would not use the area again;

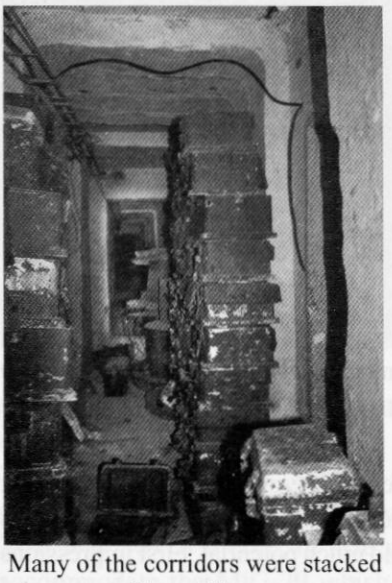


Entering the communications bunker. Photo Steve Underwood

however, they changed their minds (!). They planned to continue its use and make it the largest bombing range in Europe involving NATO forces for simulated nuclear bombing.

Since 1992, however, there have been constant protests and a stream of court cases to prevent the military from reopening the site and in 2009 the government gave up its plans. The area is still under military control, although the current Bundeswehr unit occupying the site is being disbanded in 2011. Perhaps then the area will be opened up to the public – or perhaps not, as there is no doubt a great deal of munitions still scattered over the vast area.

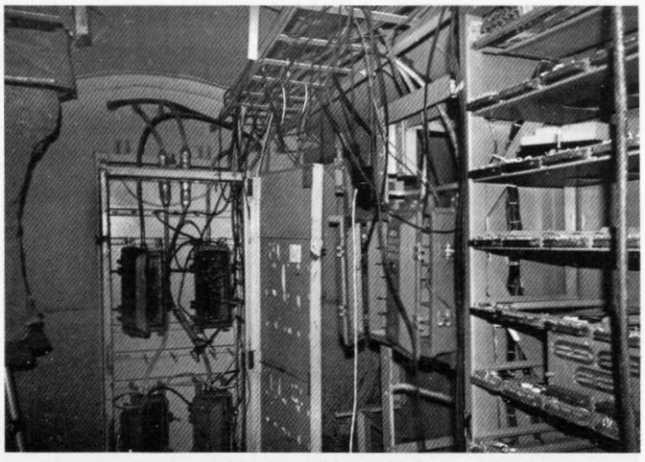
However, we were allowed in and were met by a couple of very friendly and helpful members of the German army who were to be our guides while on the range. So, back to the Kulon comms bunker: There were what looked like a couple of steel sheds covering access to the underground world of a pre fabricated communication shelter and a small switching and relay chamber. The staircase was protected by the steel box with a door. This was fixed shut but the box didn't completely cover the top of the staircase so with the help of an extendable ladder supplied by the army we were able to descend to the stairs.



Many of the corridors were stacked with metal boxes

After negotiating the three blast doors which we needed to stoop down to get through we were in the spine corridor. This wasn't much more than one metre wide with several rooms leading off. The rooms were made of cast concrete circular sections – about 2m wide and 6m long – made off-site and then fitted together in sections and buried. The corridor was stacked with heavy metal boxes nicely marked with Russian stars. I understood these were part of the mechanism for targets for the ranges. Inside the rooms were more bits of kit, mainly old electrical switchgear, bolts, wire and other goodies to poke through.

When we emerged we continued on to the communication repeater centre nearby. These repeater stations are in a series being positioned about every 14km linking up a vast cable communications network, all protected. The top was again covered by a metal shed structure. With the help of the ladder we descended two at a time; this was much smaller than the previous shelter, being a cylindrical metal tube about 6m long and 2m wide. It contained cables, electrical equipment, switchgear and gauges.



The repeater centre

We then moved off into the main 'Bombodrom' area, the vast open heathland. Initially the roads were paved and in good condition but they petered out to rough potholed tracks as we got further in. We arrived at a mock NATO airfield complete with mock runways, taxiways and real hardened aircraft shelters (HAS). This had been constructed by the Soviets to practise attacking Western airfields with bombing runs.

The MiG inside a HAS. Photo Steve Underwood.

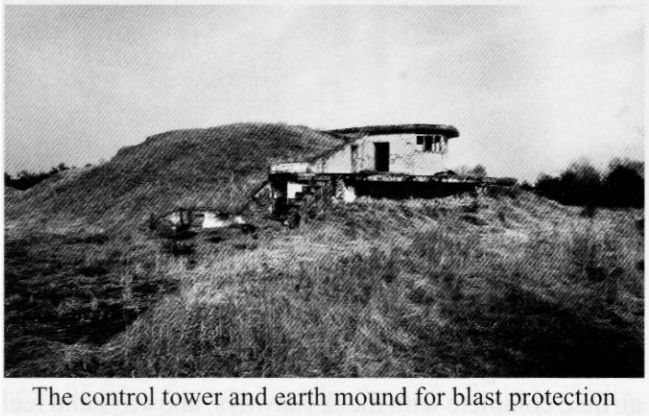
One of the hardened aircraft shelters still contained an abandoned shell of a MiG fighter partially buried in sand – all engines and instruments had gone but the basic frame was still there with the Soviet star painted on the tail fin. Now it's over to Bob Clary.

The Dummy Airfield
by Bob Clary

After we had finished taking photos of the MiG we made our way back over the sand dunes to the cars and retraced our route towards the road. A Mercedes C class saloon is not the ideal vehicle for driving over an undulating, potholed sandy track especially with five up. It was scraping its undercarriage most of the way but Mick Plock assured me it had a plastic guard underneath and no harm would be done, which was slightly reassuring.

Before we met the main road we turned left onto another track to visit a control tower. The purpose of the site was to simulate a NATO airfield so the Russian pilots could practise their tactics. The hardened shelters and the control towers were there to provide something that looked like a NATO airfield from the air though no runway was actually built.

The control tower was derelict and had two levels. A surrounding earth mound would have given it some blast protection. It commanded a good view of the "runway" and would have been used to monitor the pilots' effort in attacking the site.



The control tower and earth mound for blast protection

Three-level control tower

We then drove a short distance to another control tower which had three levels and no blast protection. Its lower stairs had been removed as the upper floors were in very poor condition. Our guide then led us back to the main road and crossed over it towards an active army base. We approached the base but turned left before reaching its main gate and proceeded down another sandy track for about half a mile or so before we parked.

We followed our guide a short distance into the woods and came to the entrance to yet another bunker complex. This was a radio and tropospheric relay command centre with the call sign KULON-1. It was similar to the one we had seen earlier in the day and consisted of several standard-sized prefabricated rooms about 10 metres by 3 metres with an arched roof. In one of the rooms items of equipment were lying around on the floor which was in surprisingly good condition.

Electrical switch cabinet and one of many internal gas doors in Kulon 1

After this we drove back to the occupied base and stopped just short of it to look around the derelict Russian buildings which hadn't been included in the current facility. These consisted of the usual buildings that are needed to house and entertain troops including blocks of flats, barracks, a headquarters building and a sauna.

We were by now running late and it was time to go to our hotel. We had booked into a Best Western at Marina Wolfsbruch not really knowing what to expect for our ‚49; however, it turned out to be a new resort hotel built around its own basin off a canal. We each got our own three-bedroom flat for the night with its own front door, and had free use of the swimming pool and sauna. It was superb. Over to Alex for Day two's write-up.

152 mm gun-howitzers in action at the Schweinrich training area

Day Two – The Wittstock Airbase
by Alex Gould

We arrived at the base in miserable weather; however it was going to take more than cold and rain to stop us exploring a site that held much potential. First impressions were of a site which had been comprehensively stripped

The history of the base – 1934 to the present

Wittstock airbase is located near Wittstock an der Dosse in Western Brandenburg, about fifty miles northwest of Berlin. Starting in 1934, the buildings and hangers were built in stages, with the base becoming operational in 1935. The site was used for a number of purposes including the training of paratroops and was an operational Luftwaffe base until the Russians arrived in 1945.

During World War II the base was attacked by 35 Mosquitoes of RAF Bomber Command on 19/20 April 1945. Following the Allied victory, Wittstock airbase and its adjacent bombing range were taken over by the Soviet air force as part of the Soviet Occupation Forces in Germany. The Russians further developed the base, adding the current concrete runway, aircraft shelters and further accommodation.

Wittstock Airbase was home to the 33 IAP (Fighter Regiment), equipped with MiG-29 (Fulcrum-A/B) fighters and MiG-23UM (Flogger-C) trainer aircraft. The unit was part of North Corps, 16 GvIAD 'Swirskaya' (16th Guards Fighter Division), with its HQ at Damgarten. Wittstock was also home to the 40th Radar Brigade, the northern radar brigade of the Group's air-defence system.

The 16th Air Army remained at Wittstock until after reunification – the last MIGs left the site for Russia on 7 April 1994 after which the base was handed over to the Bundeswehr. In 2010 the site was sold off by the Bundeswehr and demolition of structures on-site such as the HAS was underway during our visit. A number of the pre-WWII buildings are apparently listed (or the German equivalent), and therefore should escape demolition.

A line-up of MiG-29s during the formal farewell ceremony on 7 April 1994.
Photo by Lindsay Peacock

of all equipment not bolted down, and quite a lot which was! There were however a number of interesting reminders of the site's past which we dutifully explored.

Hardened Aircraft Shelters

The first area of the base which we explored was one of the Hardened Aircraft Shelter areas. These structures were built out of prefabricated concrete segments which were then earthed over for increased protection. Each shelter was designed to protect a single aircraft from aerial attack.

The HASs at Wittstock were of two types: the older, smaller type 2A/13, and the larger type 3/16. The type 3/16 was 30x16 metres in size and was intended to accommodate the MiG-29 which would not fit in the narrower 2A/13 (13m wide) shelters. These shelters were built from 1987 in conjunction with the introduction of the MiG-29 to the 33rd Fighter Regiment.

All the shelters had been comprehensively stripped of all removable items including the large blast doors and the precast concrete taxi-way sections. The taxi-ways were pulled up and taken back to Russia by train. One interesting feature of the HAS was the information panel on the walls giving shelter altitude, shelter heading and runway headings. This would have been used to configure aircraft navigation systems.

In other areas of the site, demolition contractors were busy demolishing HAS structures, and an interesting

Inside a hardened aircraft shelter (HAS)

view could be had of the shelters once the earth cover had been removed. Adjacent to the first HAS area was a large concrete apron on which the MiGs would have been serviced and fuelled. The area retained the painted marshalling markings, along with concrete bases containing pipe work and cabling for aircraft servicing.

Runway and pre-war hangars

The next area of the site which we saw was the main runway. Wittstock runway 08/26 is 2400m long by 50m wide. The surface is in good condition and is made from square concrete slabs. Around halfway down the runway a quarter-mile drag strip has been created between two lines of concrete barriers – we presume that this was built following the Russian withdrawal. Considerable fun was had driving down this runway while avoiding debris and demolition contractors on the way. Having travelled the length of the paved surface, we headed back towards

One of the pre-war hangars

Inside a hangar

the pre-war hangars to begin exploring the rest of the site, starting at the pre-war Luftwaffe hangar complex. These hangars were of brick construction, with steel roof structures supporting sectional concrete roof slabs. The first hangar entered was in poor condition with water streaming through the roof; it was also liberally scattered with rubbish. The primary point of interest here were the gantry cranes. These were obviously of pre-war design and still retained their motors and German signage. A brief climb up to the control box gave a good view of the hangar floor; however some very rotten wooden flooring precluded access to the motors and winding gear.

One of the pre-war barrack blocks

The second hangar visited incorporated a cellar. The structure of the cellar was heavily reinforced and included heavy steel doors and window shutters with rubber seals, pointing to its possible use as an air-raid shelter.

Domestic buildings

The next structure visited was a German pre-war barrack block. This turned out to be a very large structure in an approximate T-shape. The building had been heavily stripped as with all of the other buildings at the site with all fittings and pipe work removed. The block also had a cellar which stretched beneath its entire length; down below it was very dark but sadly very empty. After the barrack block we made for a mess hall. This was another large pre-war half-timber structure with two long halls around 100 metres long. The building was again in very poor condition with the ceiling collapsing around halfway down the hall. One interesting point in this building was that all the bolts holding the timber frame together were painted in bright colours.

Lenin – note the disfigured face

Then, after passing a disfigured statue of Lenin, we came to the old pre-war operational area of the site. The first building visited in this complex was the gymnasium, which was empty, but still retained some Cyrillic signs. After the gym we walked through what had been an operations building. This contained a large number of empty rooms, along with a cinema/theatre and projection room. The cinema still contained its stepped floor along with a Cyrillic sign reading 'Protect the honour, the honour of the regiment and the army!'

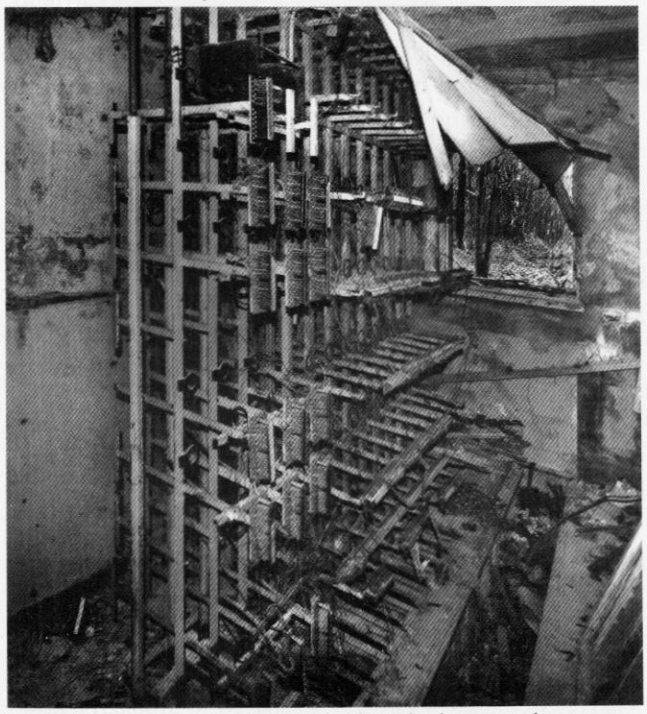
The final building visited was the former base hospital. Once again the building had been stripped of everything which could be removed. However a few features remained which were of interest including the mounts for operating theatre/dentist chair lights, some murals, and a sauna in the basement.

Cinema with the Russian banner above the stage

Hot water

Wittstock airbase had two separate district heating plants. One of these was obviously of pre-war construction, and the other was of the standard East German/Russian construction. Both boiler houses had been stripped of everything usable, but retained their boiler beds, chimneys and pipe-ducts which gave some idea as to their function. Judging from the coal dust which was much in evidence, both of these plants had been coal-fired.

Next came the base telephone exchange which was a concrete building clad in stone. Given the size of the place, the building was surprisingly small, giving rise to speculation that there may have been another larger exchange somewhere else on the site. The first two rooms were filled mainly with rubbish and broken telephones.



Main Distribution Frame in the telephone exchange

The two end rooms and the central corridor contained cable trenches with severed multi-core copper cables. The central room still contained a distribution frame, while another room had various exchange components and documentation littering the floor.

Finally we visited eleven four-storey accommodation blocks. Most of these structures were boarded up; however a couple had been left open. The block we investigated contained small one-bedroom flats. As with everywhere else at this site, the flats had been stripped back to bare concrete.

Due to time constraints we didn't get to see half of the buildings at this huge site, which leaves it ripe for a revisit. Now it's Adrian's turn.

Accommodation blocks

Gadow
by Adrian Trice

After a short drive southeast from Wittstock, we turned off the main road onto the site of four bunkers built as a command centre for the Northern Fighter Corps of the Soviet Air Force (SAF) and the Soviet Air Defence Unit (PVO). Mike gave us an orientation and briefing from the roof of one of the bunkers. The site had been developed during the 1980s and the basic structures now lay unfinished thanks to the Cold War ending before they could be completed. Briefing over, we were left to explore the complex in smaller groups.

Gadow bunker – built but never covered over

Construction methods

The bunkers' actual construction seems to be quite simple, almost like a big kit of parts. The forest floor had been cleared and levelled; the heaps of spoil that had been removed were all around us now being slowly reclaimed by nature. Then two parallel concrete foundation slabs were laid on the forest floor and precast concrete bearers were then laid side by side and welded together with reinforcing bar to stop them spreading apart; the tops of these bearers had a recess formed in them to accept the ends of the roof beams, both the bearers and the roof beams had lifting eyes once again made of reinforcing bar to facilitate their placement.

To help prevent the ingress of water a round rubber gasket was trapped in both sides of the recess and then covered over with a sand and cement fillet; the same method had been employed in the roof beam joints as they were bolted together, however the roof seals were now falling out and there was a constant dripping of water.

Inside the unfinished shell

Strangely there did not appear to be a precast solution for filling in the two ends of each semi circular bunker; this was achieved by welding vertical steel beams to the main structure and then infilling with standard brickwork, quite how they would have kept the water out remains a mystery. Once the bunker's roof structure had been completed it was the covered by thick bitumen sheeting and then covered in standard bricks; we were uncertain about the function of the bricks but maybe they were simply to hold the sheeting in place. Most of the brickwork had either been removed or maybe was never completed, but a few sections remain giving a good idea of how the structures would have looked before being covered with soil.

In order to link each of the four bunkers together precast concrete rectangular box sections had been placed between each structure to presumably house a staircase, these however were all unfinished. Holes were knocked through the roof beams to meet up with the rectangular staircase sections, and the same sections were used for the cable entry and other service ducts. Moving onto the inside of the four structures, each one was in a different stage of completion, varying from just started to internal fit out, so we were able to work out how they were actually built.

Internal fit-out

The precast method of construction continued internally; to form the mezzanine floors precast floor bearers were placed on to the bunker floor and then support lintels were lowered into place spanning the bearers, and then concrete floor slabs were lowered onto the lintels and welded together with the regulation reinforcing bar. The floor slabs do not meet the roof beams, so a large void is formed at the sides of the bunker.

The internal walls were fabricated from brick laid into vertical iron support beams which are welded at the top into the reinforcing bars of the floor slab above. Where the brickwork meets the underside of the floor slab, instead of cutting the bricks to fit in the space remaining the last course was replaced by what appeared to be a type of bag made of a silk-like material. To finish off the internal walls a terracotta mat was applied to the brickwork, held in place with yet more reinforcing bar, to form a key for the render base coat; this was in turn covered with a finish coat of render.

Upper-level decontamination area where steel door frames were fitted but never any doors

Three of the bunkers had an internal concrete wall built from top to bottom; these are built in the middle spanning the sides of the roof beams – various holes for ventilation, pipes, cables and other services had been formed into these walls during construction. Some of the floors had been screeded and once again pipe work for the services had been laid under the screed.

We made our way back to the cars where the others were having a drink and a bite to eat. We just had time for a quick look around the domestic camp but the buildings were in a very poor state of repair and given our time constraints we decided not to look at them any further.

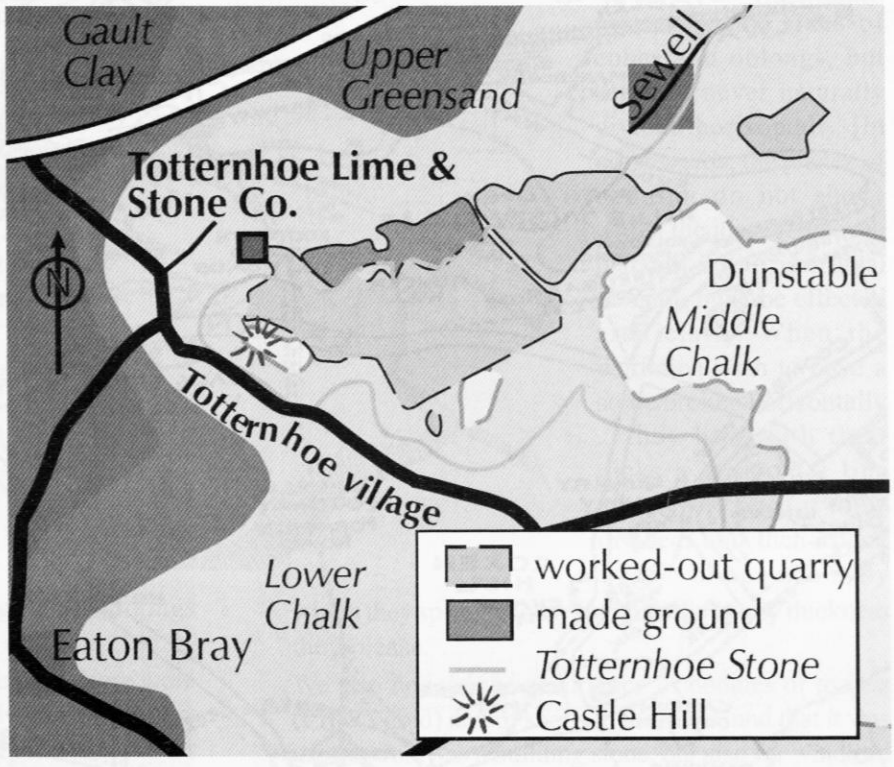
Returning to the cars, we passed by a few pieces of ordnance by the side of the road, with two rather sizeable bombs in amongst the other suspicious-looking articles. We left them well alone, a stark reminder that once the autumn leaves had covered the footsteps of our visit, the legacy of the site's previous occupants will be there for many years to come.

Photos by Nick Catford unless stated (excluding the two 1987 archive pictures)

The Totternhoe Quarries (Lower Chalk): An Underground Source for Building-Stone, Bedfordshire

By Paul W. Sowan

Totternhoe in Bedfordshire is on the north-facing escarpment of the Chiltern Hills, very close to the Hertfordshire border, six or seven kilometres southwest of Dunstable, and about ten kms west of Luton. It was credited with two manors in the Domesday survey of 1086, although these evidently merged into one subsequently. The parish has been famous for its building-stone, quarried from the Lower Chalk (opencast and underground) for many centuries.



The distinctive stone has been reported from a nearby Roman (third/fourth-century) villa, and from Roman foundations at Edgware Road in London. A Norman motte and bailey castle at nearby Totternhoe Knoll, John Catt has suggested, was built 'for the protection of the quarries and mines' although there is no clear evidence for underground rather than opencast quarrying at that date. A quarry is mentioned in a charter of c.1132 whereby Henry I endowed a house of Austin Canons at Dunstable with land at Totternhoe. And two quarries at this place were owned by the Benedictine abbey at St Albans from the mid-fourteenth century to the dissolution of the monasteries by Henry VIII in 1535–1540.

Stone for building has been raised, latterly from opencast quarries and particularly for architectural restoration, into modern times. Most recently a small open pit at TL 988222 has been the source.

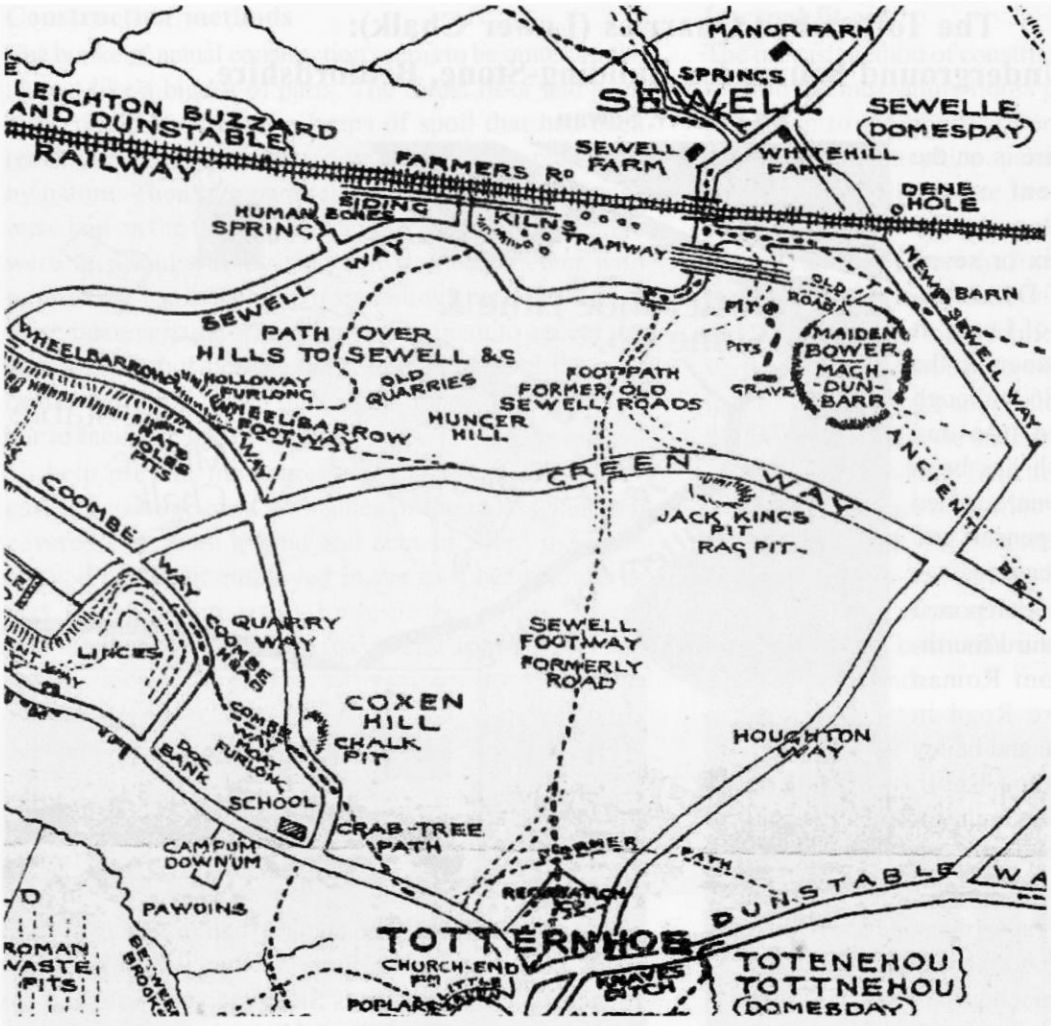
Chalk lithology and stratigraphy

Chalk is generally a very soft and pure limestone, mineralogically overwhelmingly composed of calcite (calcium carbonate) in the form of micro-fossil fragments (coccoliths) derived from planktonic algae. It is the characteristic sediment of the Upper Cretaceous period deposited from continental shelf seas between about 100 million and 83 million years ago. The oldest and lowest beds contain up to 25 percent or more of clay minerals, this chalk being pale grey rather than white. But the much thicker higher beds of chalk (and the most extensive outcrop) are almost pure calcite (if the embedded flint nodules are ignored) and very porous and very white.

As Derek Ager has pointed out (1981), virtually identical rock of the same age, and containing the same fossils, occurs throughout much of Europe, and indeed worldwide, reflecting an Upper Cretaceous marine transgression, or period of very high sea levels flooding continental margins. The chalk so familiar in the White Cliffs of Dover can be found in the cliffs of northern France, the Danish islands Sjaelland and Møn, and the Black Sea coast of Turkey. And indeed in Georgia, Egypt, Israel, Texas, and Western Australia, and other places. Near the margins of the basins in which the sediment formed, the lithology differs markedly. In south Devon we find sandy chalk, and in southern Sweden can be seen chalk containing embedded pebbles of granitic gneiss, for example; and in Yorkshire and Northern Ireland the chalk is a markedly harder rock than in the southeast or in France.

Within the up to 1,000 feet or so total thickness of the British Chalk (at its greatest development in Norfolk) there are however considerable variations in lithology. In a few places, particular lithologies have been found of sufficient quality as building-stone to be used at considerable distances from the quarries where they were extracted. Most famously, this has been the case at Beer (Devon) which supplied stone for Exeter Cathedral, and Totternhoe (Bedfordshire) from which stone for Windsor Castle was derived. Less well-known are underground quarries in hard chalk for building at Guildford and Mickleham in Surrey (Sowan, 1984). And chalk appears also to have been quarried for building stone in the lowest levels of chalk pits at a limeworks at Amberley (Sussex).

Another distinctive variety of chalk, called *clunch*, has been dug for the same purpose in and around



From W.G. SMITH, 1904, Dunstable: its history and surroundings. 'Old quarries' are indicated southwest of Sewell. Note also the 'denehole' southeast of Sewell, by the railway. This is not referred to in Smith's text, and seems unlikely to be correctly identified by him

Cambridgeshire. And chalk of no particular suitability as a building-stone has also been widely used internally, especially in internal walls, cellars, and for lining wells, including for example sixteenth- and seventeenth-century buildings in Croydon and Reigate.

As Roger Cordiner has pointed out, it is entirely inappropriate to refer to chalk used generally as a building-stone as clunch, a term which should be reserved for a specific lithology from a specific district. Nairn and Pevsner, in the Surrey volume of the Buildings of England series, even describe the highly siliceous Reigate stone (Upper Greensand) as 'clunch'! Roberts (2008) emphasises that the stone 'is not an equivalent of clunch (Cambridge chalk marl). Warnes (1926) says the crushing strength of 'true clunch' is 72 tons per square foot, and of Totternhoe stone 124 tons.

John Catt (2010) provides an excellent up-to-date account of chalk geology. The most up-to-date stratigraphical account of the British chalk is that of Rory Mortimore et al. Totternhoe stone, using Mortimore's scheme, occurs at the base of the Zig Zag Chalk beds of Middle Cenomanian age, deposited between 96 and 95 million years ago. The bed equates with the bio-zone of the ammonite Acanthoceras rhotomagense.

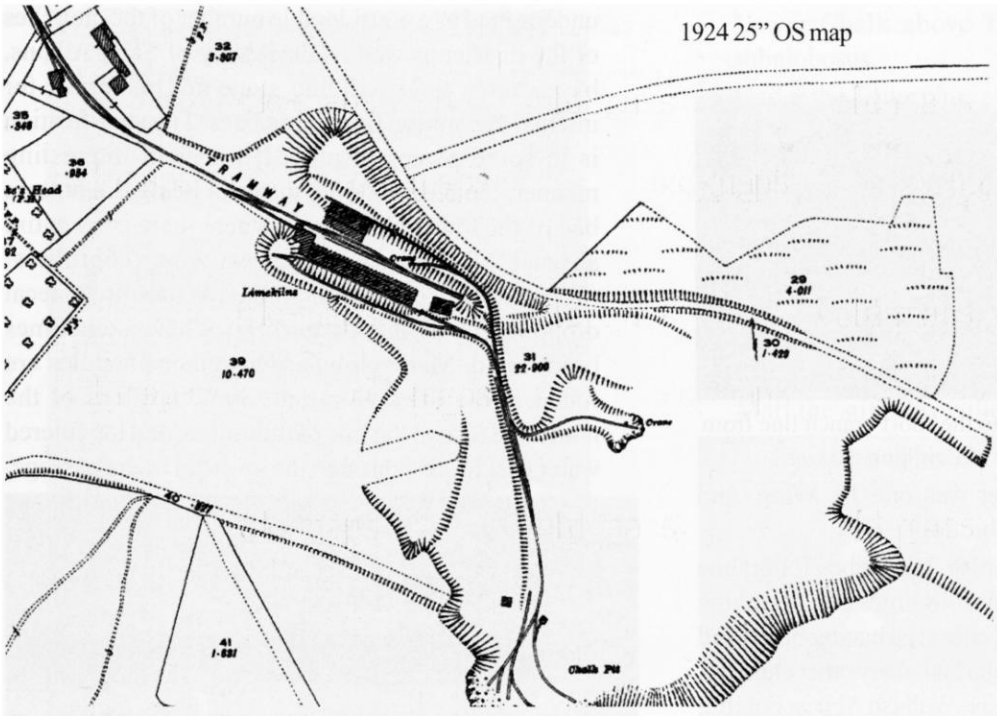
Economic exploitation of chalk

This valuable mineral resource has often been mined or quarried underground, certainly throughout Europe, for a variety of purposes. I have been fortunate to see the chalk 'from the inside' in subterranean excavations in Belgium, Denmark, France, the Netherlands, Poland, and Sweden, for example, as well as in England. The primary purpose of these underground workings has been as a source of building-stone, agricultural lime, lime for making mortar or cement, or as an additive to the clay in brickmaking, amongst numerous other end-uses. A useful overview of the historic economic uses of chalk, whether worked opencast or underground, has been provided by Jukes-Browne and Hill (1904).

Careful archaeological examination of underground workings in the chalk, and of nearby buildings, and a close study of historical sources are required if the primary purpose of underground workings is to be identified, whether as a source of flint, or of large blocks for building, or of large chalk lumps as feedstock for lime kilns, or as an ingredient in brick-making, for example. An examination of chalk mines at Emmer Green, north of Reading, leads to the conclusion that most of the material was ground up and mixed with clay for brick-making, although some chalk and the larger flints were taken out for use in local buildings or in road-making.

The quarries: historical accounts

Pehr Kalm [1715–1779], from Finland or Sweden, visited England in 1748 on his way to north America, and described, inter alia, the quarries at Totternhoe. His travels were published in two volumes in Stockholm in 1753; an English translation by Joseph Lucas was published in 1892. He recorded one of the quarry tunnels as having a length (in modern units) of 206 metres, and reported being



1924 25" OS map

told by the quarrymen that the underground workings were perhaps from 500 to 1,000 years old.

> This freestone is dug deep under the hills. Here were three places, where they had formerly hewn the same, and where adits down at the foot of the hill went far under the earth, or the Chalk hill. I was as far in as the ends of two, one of which went as far as 40 poles (= 660 feet). At the entrance the adit was walled for about 12 feet, to keep it free from slips. After getting about 40 feet into the mine there was no more daylight, but it was coal-black darkness, as of night. The breadth of these adits underground was for the most part 6 feet, the height 7 feet. The water now trickled down everywhere through the roof, or vault, of the adit, from the hill above. .. Both roof and walls were very uneven, for sometimes the sides projected and sometimes went in hollows. .. The adits went most horizontally, yet they sloped a little down in some places. On both sides of the main adit there went other adits, both at acute, right and obtuse angles; so that, if the entrances of all these cross-galleries had been open there would have been, to one unacquainted with them, the worst labyrinth and maze there could possibly be; but these adits were now mostly filled up with the loose bits of freestone which had been broken off in the process of hewing.
>
> The stone divided itself here in the mine all in cracks or fissures, which all went from above downwards more or less perpendicularly, but no fissures ever ran horizontally or very obliquely, which was the unanimous account of the workmen. These fissures were sometimes broad, six inches wide or more, sometimes quite narrow, but nearly all very deep, so that a stick four feet long could be stuck into them without reaching the end of them.
>
> These stones naturally clear each other perpendicularly on all sides, and form as it were perpendicular sides of cubes and oblongs, but they are never naturally divided horizontally [in other words, the planes of bedding do not show, whilst the joint planes are marked], but all horizontal division must be effected artificially. When the workmen wish to have a stone broken horizontally .. they hew with their picks a horizontal line where they wish it to be divided, and then knock wedges of iron into it, by which they spring it loose horizontally to any thickness they please. …
>
> We also noticed the occurrence of nodules of pyrites (Crow's gold) and of shells in the stone, and that it was used not only as a building stone, but also for window-frames and door posts, and arches over fire-places, windows, and doors, for several kinds of pedestals and pillars, the bottoms of baking ovens, etc.

A watercolour by George Shepherd (above), made in 1813, depicts an adit entrance taller than wide, alongside which are men and a cart and two single-storey buildings.

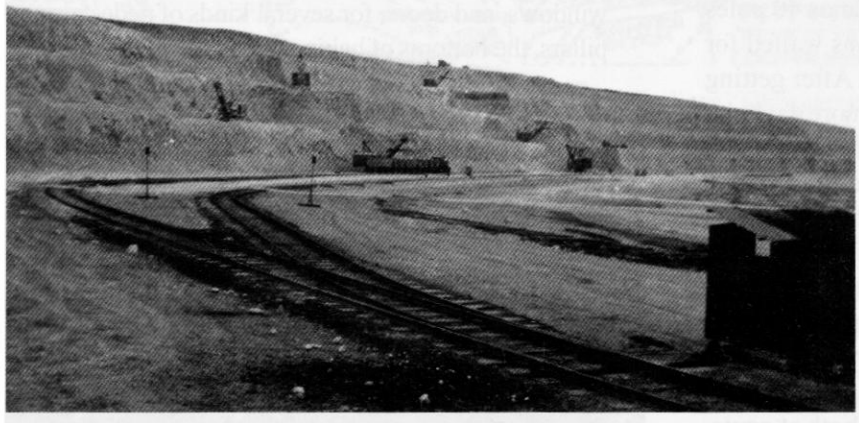
An 1830 directory for Bedfordshire (reprinted 1992 by Winton) notes that at 'Tattenhoe' there was a valuable quarry, owned at that time by Lord Bute, who was then using the stone to rebuild his 'splendid mansion' near Luton.

Totternhoe was considered, along with another 108 quarries nationwide, as a source of stone for rebuilding the Houses of Parliament after the Palace of Westminster was largely destroyed by fire in 1834, but it was not selected.

The rope worked incline down to the short branch line from the Luton and Dunstable to Leighton Buzzard

In 1858 (Hunt) the freeholder was one J.J. Wing, and the stone sold at 1s 3d per cubic foot.

Laxton's builder's price book for 1867 describes Totternhoe stone as a greenish-white argillaceous limestone, weighing 116 lbs 8 oz per cubic foot, and cites it as having been used in Dunstable Priory Church, Luton and many other churches in Bedfordshire and Hertfordshire, Woburn Abbey, Fonthill House, Ashridge House, the organ screen at Peterborough Minster, etc. It cost 1s 3d per cubic foot at the quarry, and was sent by land five and a half miles to Leighton, thence to London via the Grand Junction Canal, where it sold at 2s 5d per cubic foot.



Open chalk pit in April 1967 with rail tracks laid out on flat quarry floor. A train of c. five waggons is being loaded by excavator machine at foot of the chalk face. The entire height of chalk face is being worked in three benches (above quarry floor) of c. 5 – 6 metres each in height with mechanical excavators at work on each bench

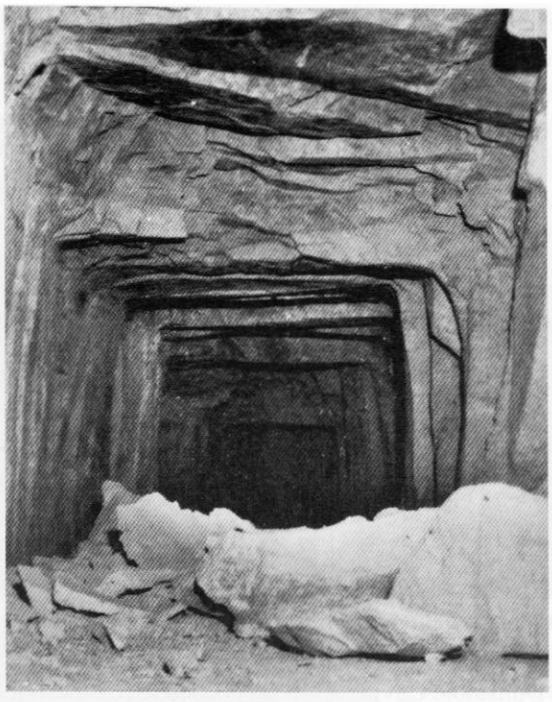
Wyatt (1872) stated that ..

> The principal quarry is entered by a level adit, where a tunnel is made to a considerable distance, and the galleries on each side show where the clunch or Totternhoe stone has been worked out. Occasionally the modern excavators have come upon some old workings; and it would appear as if there had been a sudden collapse, or caving in, of some portion of the strata, causing the abandonment of those drivings, as several tools were found, all of them being of different forms to those now in use. It is probable that a large area of this portion of the Downs has been undermined as a considerable number of the churches of the district as well as the Abbey of Saint Albans, have drawn their building stone and materials for internal decoration from these beds. The stratification is in some places displayed in a very interesting manner, the best building material being the bottom bed of the lower chalk rock, where there is an entire absence of flints. In the lowest zone 'coprolites' (Coprolites are usually interpreted as fossilised faecal droppings) and shark's teeth [sic] have sometimes been found. Many globular ferruginous nodules are found in the lowest stratum. Some portions of the tunnel are just on the line of saturation, and the filtered water trickles fast through the low roof of the passage.

This is an external view of a timbered square quarry-tunnel portal in September 1957, with four seated men and a wheelbarrow (although no tools are visible). This seems to imply the men were equipped for / expecting to move material about underground. This portal may have been as originally made or, on the other hand, may have been re-exposed by the use of a mechanical excavator and timbered for safety (the latter options seems more plausible). Some large timber baulks lying about may have been introduced is connection with modern roof support installation. What might be older timbers on the right may be re-excavated older tunnel support recently brought to light perhaps by digging out the entrance to gain access

Jukes-Browne and Hill (1904) reported that the stone 'is still occasionally quarried for building stone' ..

> At Totternhoe the best stone is in two beds, each about 4 feet thick, and can be worked as a freestone, but the beds are traversed by joint planes, which divide them into cubical blocks; masses weighing a ton can be obtained. The upper beds (9 feet thick) are less hard and do not stand the weather so well as the middle beds, and the lower beds are in thinner courses. The stone is now only worked in the open quarry, but formerly adits were driven into the hill along the outcrop of the stone.



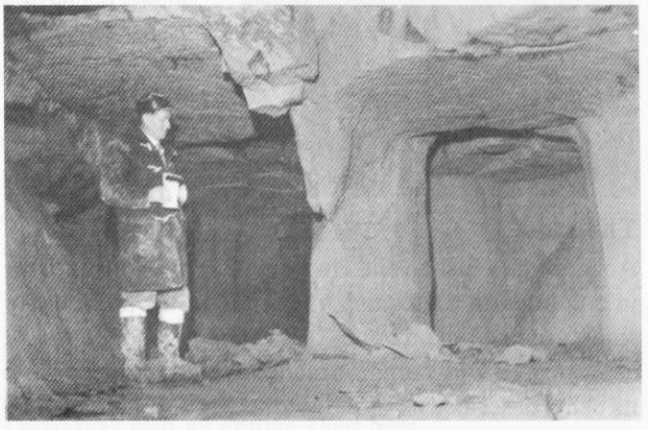
A square-section quarry tunnel with fairly smooth vertical side walls and a predominantly flat roof evidently of slabby chalk; there are several large lumps of fallen chalk on a flat floor

In 1904 G. Worthington Smith said of the quarries:

> It will take some time to explore the steep grassy slopes between the lime kilns and the Green Way. In one valley will be seen at the extreme bottom the ruined entrances to the long quarry passages from which Totternhoe stone was extracted in medieval times for the building of local churches and mansions. The great church and Priory of Dunstable, as well as parts of St. Alban's Cathedral and Westminster Abbey were built of this stone. The hills at this place are said to be honey-combed with galleries made in past times in the search for this material. That the passages extend for long distances is certain, as the writer, aided by cords, and a lantern has traversed some of them. The subterranean passages are wet and unsafe, as the chalk has fallen from above, and has made exploration difficult and, in some of the passages, impossible. The stone is exposed on the surface in certain places, and was known to the ancient Britons and Romans as well as the medieval builders.

He later describe the geological setting of the stone beds:

> We now come to the Lower Chalk and Chalk Marl beneath Dunstable Town. At 80 feet beneath the town surface Totternhoe stone is met with: there is six to ten feet of it, and on this stratum springs of water occur.
>
> Totternhoe stone, at Totternhoe, contains such fossils as Pecten orbicularis, but it is very much richer in fossils at Chalton. Sometimes the water is 15 feet above the stone, or 65 feet beneath the surface. Water cannot be got at Dunstable without an excavation of from 65 feet to 80 feet. A characteristic fossil of the Lower Chalk above Totternhoe stone is Holaster subglobosus.
>
> Under the Totternhoe stone is Chalk Marl or clay for 90 feet; it ... undulates and varies in depth from 60 feet to 120 feet ... This Chalk Marl is impervious to water, and its characteristic fossil is Ammonites varians. The Dunstable Waterworks are excavated into about 35 feet of Chalk Marl. Mr. Bennett's deep well at the Brewery is carried down to 100 feet in the same substance.
>
> At 80 feet under the Totternhoe stone through Chalk Marl the stiff clay called the Gault is met with.



This appears to show a short dead-end excavated bay on the right, diverging at an acute angle from a main gallery on the left. The standing figure indicates a ceiling height of the order of six feet or more. The irregular ceiling at the junction is interesting, perhaps indicating an 'accidental' junction. The floor is flat, and mostly clear of even small fallen chalk

Elsden and Howe recorded the quarries as still, if sporadically, active in 1923.

> At the present day the output is comparatively small and irregular, and open works tend to take the place of mines, for it is possible to use the softer chalk overburden for lime. ...

Laxton's builder's price book for 1934 records the Totternhoe Lime & Stone Company Ltd working what is described as 'clunch stone' which was sold at 3s 6d per foot 'on truck at Stanbridgeford Station'. Stanbridgeford (the station has long since closed) was on the London & North Western Railway on the former Luton and Dunstable to Leighton Buzzard line.

An article (Anon) in the journal of the South Bedfordshire Archaeological Society in 1955 stated that 'considerable interest has been shown recently in the reopening (and subsequent blocking) of one of the entrances to the Mediaeval stone quarries at Totternhoe.' This states that it was (in 1955) 90 years since the first 'modern' quarry was started (so in about 1865), and 'since then there has been a constant danger of cutting into the old workings.' And further that the quarries were accessible until about thirty years ago (1925) when they were 'blocked up for safety.'

There is no scale, but the block lying on the floor is of square section and about five times as long as its width. The two massive blocks behind are more or less cubical although their further parts are not seen and they may in fact not have been completely detached from the rock face. They could be about half a metre square

The stone

According to Elsden and Howe (1923) the stone is 'grey in colour, with a greenish tinge, due to the presence of small grains of glauconite … Its harshness to the touch, as compared with common chalk, has led erroneously to its being described as a sandy stone ..' The total thickness of the beds is reported as up to seventeen feet, but the best stone was from two four-foot [thick] beds near the base. Roberts (2008) described the stone as 'compact and fine-grained' and as granular, hard and gritty and containing polygonal calcite prisms being fragments of the shells of Inoceramus.

The quarries: modern accounts

The Rugby Portland Cement Company investigated the underground quarries in 1957 preparatory to excavating the overlying chalk for lime or cement manufacture. The photographs accompanying this article appear to have been taken during the course of these investigations. A survey of the layout and positions of the identified underground galleries has been published by Joan Curran (2005), to whom we are indebted for the most comprehensive modern account of the quarries.

Her account is illustrated by maps and plans, sections, and photographs giving a good impression of the nature, extent, and appearance of the underground galleries and the surface topography. A western set of tunnels has probably been largely quarried away, firstly by the removal of grey chalk overburden taken as feedstock for a former limeworks dating from 1869 onwards, and secondly by working the Totternhoe stone opencast (some is still worked for architectural repairs). Two further sets of quarry tunnels to the east had, between them, at least four adit entrances, all of which are now sealed. All the then accessible tunnels were surveyed in 1957–58, and the results of that work are reproduced at a small scale in the book.

The remainder of her book is primarily, and very properly, devoted to the architectural use of the stone in buildings, equally well illustrated.

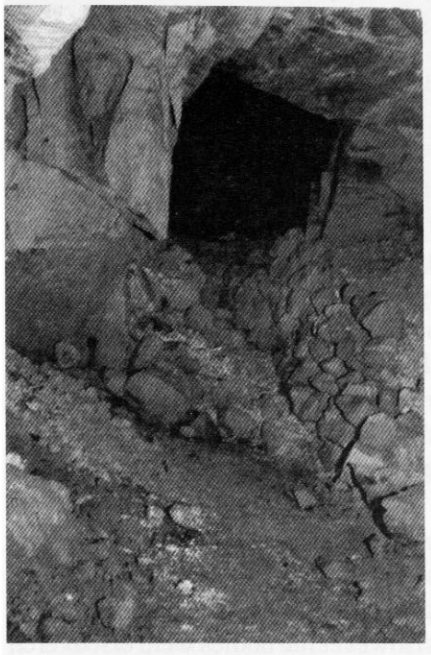
St Mary's Church in Luton, one of many local buildings to use Totternhoe stone

The Dunstable Caving Club succeeded in re-entering two of the underground quarries in 1972 and 1973, and the following information is taken from their Journal No.1 1973-4 and No. 2 1974.

> At midnight on 16.12.72 Ian Kemp, Chalky (White) and Kevin X lifted a large steel and timber lid in a disused quarry at Sewell to reveal a stable shaft 9m deep and 1° m in diameter. The first two made a descent and at the bottom a small hole gave access to a large chamber with several passages leading off. Most of these proved to be blocked by roof falls or walls of 'deads' (waste rock left in the quarry). However on the right of the shaft, in one of the collapsed sections, a loose crawl led to a small drop into some lower workings. They then spent about two hours in exploring a series of very stable passages with a cross section averaging 3m x 2.5m.
>
> On 6.1.73 a larger party, including members of the Derbyshire Caving Club, entered the mine, and several people became temporarily lost in the quite impressive labyrinth. Four carvings and a very interesting poem dated 16 November 1756 were found, as well as material left by the miners who were known locally as Carls.
>
> A third visit on 3.2.73 located a new Upper Circle. Some 280m of passage was surveyed, bringing the total passage explored to an estimated 1.6 km. The club decided to give the mine the temporary name of Hunger Hill, until such time as the original name can be traced.
>
> The scene of action then moved to an active quarry with traces of a mine under the quarry floor. This was given the name of Castlefield Mine. A dig was started on 28.4.73 and broke into a small chamber, but the way on was blocked. However in the following

week more digging broke into 28m of large passage which was named West Passage.

Shortly after this, the quarry owners withdrew their permission to explore, and the farmer at Hunger Hill Mine deliberately blocked the shaft.



Quarry gallery – note the very crude dry stone wall on the right

Down and Semmens (1996) have published some information relating to the opencast chalk pits and limeworks at Totternhoe.

Current status

The current status of chalk mines and quarries in general varies from that of a 'statutory nuisance', as at Reading in the last ten years or so where mining subsidence has ruined houses, to tourist attractions, as at or near Beer (Devon), Chislehurst (London Borough of Bromley), Viborg (Denmark), Chelm (Poland) and Hassleholm (Sweden)

In the 1980s 'Hunger Hill' was completely quarried away for cement and lime. The worked-out quarry is now an arable field lying at the level of the upper surface of the Totternhoe stone. The area from where the medieval tunnels were dug is now designated a Site of Special Scientific Interest (SSSI) called Totternhoe Chalk Quarry, as an example of chalk grassland. It is managed as a nature reserve by the Wildlife Trust for Bedfordshire, Cambridgeshire, Northamptonshire and Peterborough.

In recent times the stone has been quarried in an area between the Knolls and the underground quarries. This has been designated an SSSI called Totternhoe Stone Pit.

The stone is quarried by a family-run business, H.G Clarke and Son, started in 1920 by Herbert G Clarke. It was then passed to his son Stanley W Clarke and is now being run by his son Angus J Clarke. H.G Clarke and Son are the main suppliers of this rare English stone. An original quarry adit can still clearly be seen in one of the quarry faces.

The quarries were connected to the Leighton Buzzard–Dunstable railway. Wagons of stone were lowered down a 1 in 10 rope-worked incline to exchange sidings alongside the Dunstable line east of Stanbridgeford station. There was also an engine shed here.

At times of peak production, there were up to five trains a day with as many as 42 wagons per train. The wagons were bound for Long Itchington in Warwickshire where the chalk was used for the manufacture of cement. Rail transport ceased due to increased costs on 15 April 1965.

Thomas Telford's Menai suspension bridge chain and anchor tunnels, Anglesey and Caernarvonshire, North Wales

Amongst the engineering achievements of Thomas Telford [1757 – 1834] must be numbered the suspension bridge over the Menai straits from Caernarvonshire to Anglesey in north Wales. Work on this was commenced in 1819, and included a novel kind of subterranean site, described in Samuel Smiles' *Life of Thomas Telford* in the following terms ...

> The mode by which the land ends of these enormous suspension chains were rooted in the solid ground on either side of the Strait was remarkably ingenious and effective. Three oblique tunnels were made by blasting the rock on the Anglesey side; they were each about six feet in diameter, the excavations being carried down an inclined plane to the depth of about twenty yards. A considerable width of rock lay between each tunnel, but at the bottom they were all united by a connecting horizontal avenue or cavern, sufficiently capacious to enable the workmen to fix the strong iron frames, composed principally of thick flat cast iron plates, which were engrafted deeply into the rock, and strongly bound together by the iron work passing along the horizontal avenue; so that, if the iron held, the chains could only yield by tearing up the whole mass of solid rock under which they were thus firmly bound.

This was illustrated as follows, from which it is clear that of the four load-bearing chains, two shared a central tunnel, with one chain each in the flanking tunnels. There are actually two linking or cross-caverns, in the upper one of which the chains are held by 'cast iron saddles'. The lower or main chain chamber, where the chains are anchored, is provided with a drainage tunnel, allowing accumulated rainwater to escape. Possibly (it is not stated in Smiles' account) this was also the route by which the workmen who anchored the chains left their completed work. There was a similar arrangement on the Caernarvonshire side.

Four Miners Die in Gleision Mine, South Wales

This report has been compiled by Roger Gosling from newspapers and websites, primarily the BBC website, the South Wales Argus, the Daily Mirror, the Sun, the Daily Telegraph, the Guardian, Wales online and the Miners Advice website.

Four coal miners died on 15 September 2011 in a flood at Gleision pit, a small mine operated by a team of ten employees, seven of whom worked underground.

The miners who died were named as:

David Powell, 50, from Godre'r Graig,
Charles Breslin, 62, of Cwmllynfell,
Phillip Hill, 45, of Resolven, Neath and
Garry Jenkins, 39, of Rhiwfawr, near Cwmtwrch.

Neighbours

Their bodies were found next to the section of the mine where they had been working, indicating they had almost no time to escape the flood. Miners Dan Powell, 26, and Mark Lloyd, 45, next door neighbours from Godre'r Graig in the Swansea Valley, were leaving the mine's exit tunnel when the inrush occurred. They sprinted to safety and called the emergency services just after 9am. Mines manager Malcolm Fyfield, 56, was hauled out soon after with a serious head injury; he was flown to Morriston Hospital, Swansea.

The accident happened when the miners broke into what is believed to be some old mine workings which held a considerable volume of water; this caused a flash flood into the current workings and the miners were drowned. It was originally hoped that the miners were trapped at the far side of the flooded section. However over the next two days as the water was pumped out the miners were all found dead, the last two 33 hours after the flooding.

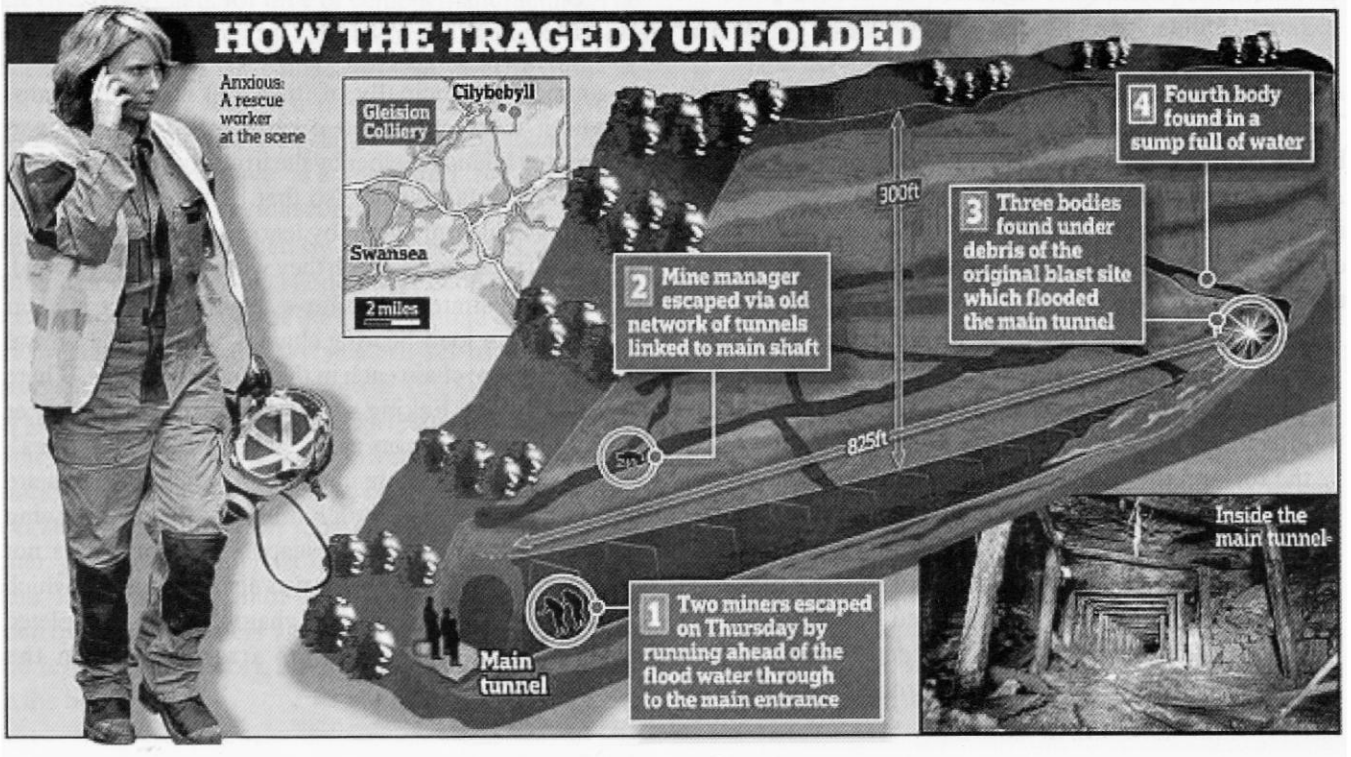
When expert rescue teams arrived, they spent the day and night pumping thousands of gallons of water, thick with debris and silt, out of the mine. Cave divers from the South and Mid-Wales Cave Rescue Team went into the mine but were forced back due to lack of visibility and debris in the passages.

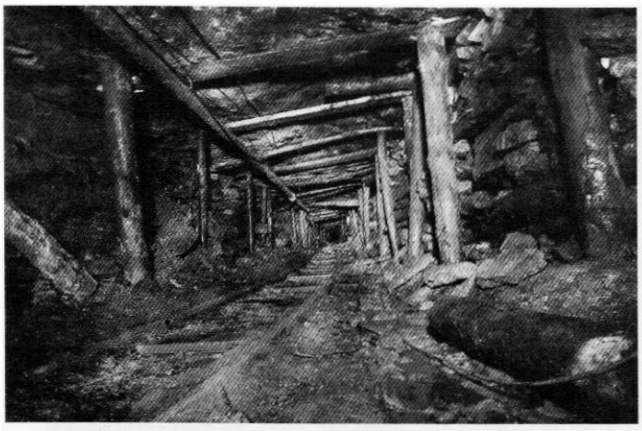
Gary Evans of the Cave Rescue Team said: "We brought in some divers to see whether it was possible to go through and speed things up. They went into the water to see whether any progress could be made that way, and they went about 20 to 30 metres, but they weren't able to go any further. They had hoped the divers could assess the situation before all the water had been pumped out, but debris had made the water murky. Despite the lack of contact with the men, [at that time] they remained very hopeful".

It is believed the miners would have fled to an air pocket to await rescue. Also a team from Sure Wave Technology, based in Cheshire, was brought in to detect movement deep underground. However the bodies were discovered over the next few days.

Lucky Escape

Two of the survivors were interviewed by police and mining experts to confirm the cause of the accident. The pit owners will also be questioned amid growing fears that the men were putting themselves at risk because of the growing demand for Welsh coal. A key witness is Daniel Powell, 26, who escaped the flooded mine knowing his father David, was trapped in the flash flood


HOW THE TRAGEDY UNFOLDED
Anxious: A rescue worker at the scene
Gleision Colliery
Cilybebyll
Swansea
2 miles
4 Fourth body found in a sump full of water
300ft
3 Three bodies found under debris of the original blast site which flooded the main tunnel
2 Mine manager escaped via old network of tunnels linked to main shaft
825ft
Inside the main tunnel
1 Two miners escaped on Thursday by running ahead of the flood water through to the main entrance
Main tunnel



This photograph from 2008 shows when the mine was derelict, before the current owners bought it

300 feet underground. It is not clear if the miners were aware that trapped water lay so close to the section they were working. While more modern mines are carefully mapped, records about historic workings like those around Gleision are not always kept.

One theory is that the water may have collected in an older abandoned mine. Dr Eric Wade of the Open University said such mines should be drained before work is allowed nearby. He said that British mining safety legislation is among the most advanced in the world, but the work is still hazardous. "Mining is in fact a dangerous occupation and perhaps you can't remove the danger entirely but you can try to ensure you minimise the risk. If you're going to work in these areas before you start your mine up you should attempt to de-water some of the old workings and this would give you another margin of safety."

Full Investigation

Safety experts have promised that lessons will be learned following the incident. A spokesman for the HSE said: "A full report into the causes of the accident is to be published in due course to ensure that any lessons can be applied." South Wales Police, the Wales Office and the HSE have launched a joint investigation to find out how the Gleision Colliery tragedy happened. The HSE has said the Mining Inspectorate's records showed no enforcement notices on the Gleision colliery, which was due an inspection later this year. The investigation will focus on what caused the deadly inrush of water which rapidly flooded the Swansea Valley colliery. It is understood explosives were being used to get anthracite from the seam in the run-up to the accident.

The law requires managers to employ a surveyor whose job it is to provide maps of nearby workings so miners can work a safe distance from them. Regulations state mining should not be carried out within 45 metres in any direction of a layer of rock containing water, or any disused workings that are not linked to mines.

Miners' leader Tyrone O'Sullivan, who led the Tower Colliery buy-out, said water inrush was a recognised problem. He said: "Coal has been worked in Wales for 200 years and longer and there are lots and lots of old colliery workings slowly filling up with water. It's something you have to be aware of and cautious of and you tend to 'drill ahead' and look for signs of any water. But it can happen no matter what precautions you take."

Footnote

The pit manager, Malcolm Fyfield, who escaped after the catastrophic flood, was arrested on 18 October 2011 by South Wales Police. Mr Fyfield, 55, was taken to Port Talbot police station under suspicion of gross negligence manslaughter, on the basis of evidence gathered by the Health and Safety Executive (HSE) and the Crown Prosecution Service, which are working with South Wales Police to investigate the circumstances surrounding the accident.

Brief History of Gleision Colliery

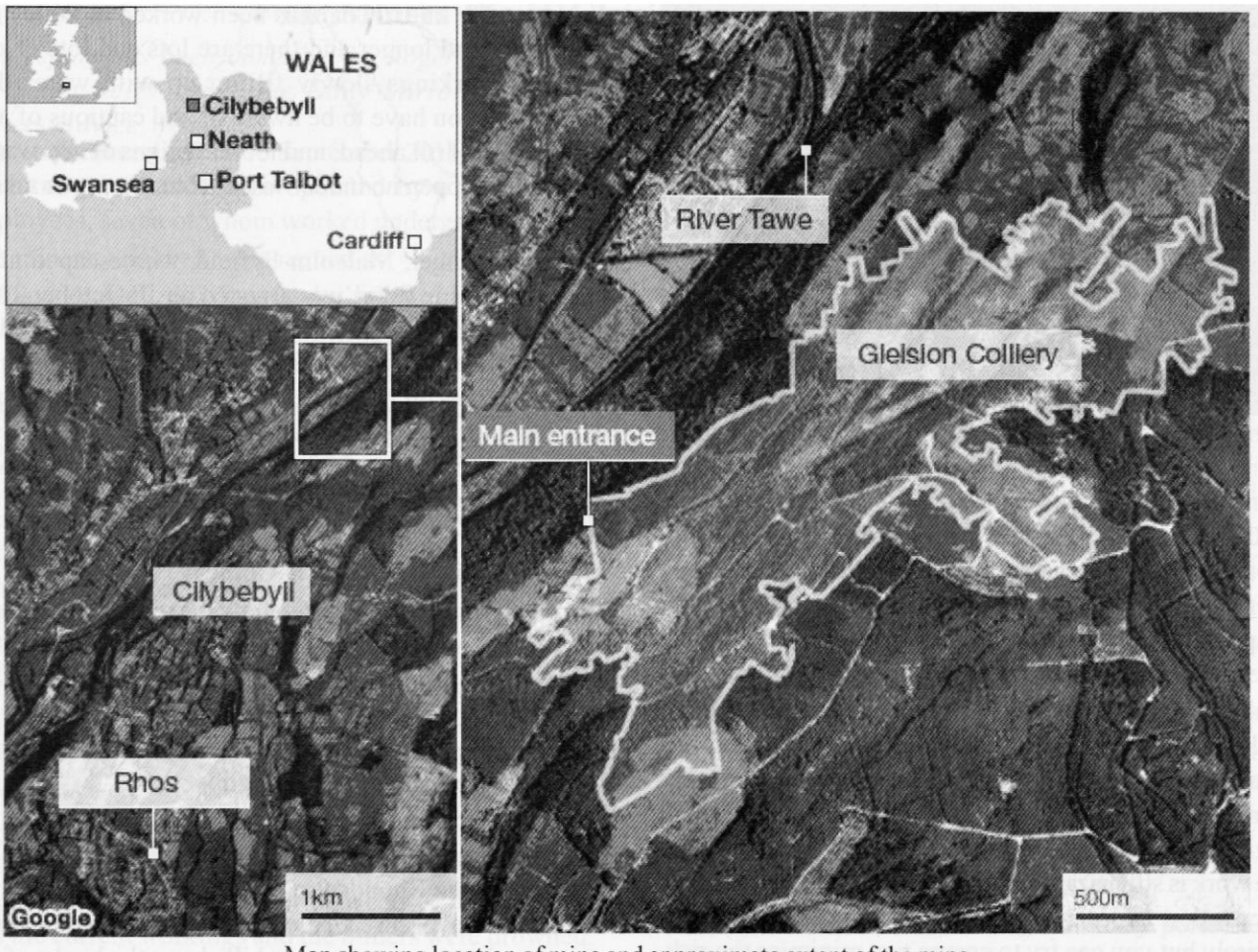
Across the country and throughout the world, south Wales was once famous for its mining industry. For many hundreds of families in the area, mining was central to their lives and bound communities together. But by the end of the twentieth century the Welsh coal industry had dwindled from its former strength.

The Gleision mine at Cilybebyll has been run off and on for five decades. It is a small drift mine working a coal seam from the Rhondda in a remote location cut into a hillside in the Swansea Valley. Access to the mine is down a narrow lane on a very steep hill above the banks of the river Tawe. It's different from the classic image of a coal mine, reached by a shaft. "A drift mine is one that can be accessed by foot," said Wayne Thomas, official with the National Union of Mineworkers (NUM) in south Wales. The current owners have operated the mine since 1993.

Gleision Colliery is one of just a handful of small mines left in the area. Another, Nant Hir mine in Glynneath, closed in 2010. In 1992 there were around 85 such drift mines operating but the trade has been in steep decline. Just four small drift mines still exist in south Wales, two in the Swansea Valley, one in Neath and one in southeast Wales. A number of larger mines are still active, running bigger operations in the area.

Wayne Thomas said the rise in the price of coal and the quality of the anthracite in the local area had seen mining become more profitable in recent years and led to a "resurgence of interest". There are two larger drift mines in the area, US and Canadian owned, one employing around 300 men and another around 160. But the Gleision colliery is much smaller.

Mr Thomas said: "This is a small-scale operation, a far more physical method of mining." Typically, the miners work in six-foot high areas, boring holes to use explosives and working out the coal with shovels. Working in such a condensed way is what gives the anthracite such a high value, Mr Thomas said. "This does mean there are limitations to the



Map showing location of mine and approximate extent of the mine.

UK mining disasters

The death of four miners in a Swansea Valley mine is the latest tragedy in a once notoriously dangerous industry.

439 killed in 1913 at Senghenydd, Glamorgan – explosion

361 killed in 1866 at Oaks Pit, in Barnsley, Yorkshire – two separate explosions

295 killed in 1894 at Albion Colliery in Cilfynydd, Glamorgan – explosion

270 killed in 1878 at Prince of Wales Colliery, in Abercarn, Monmouthshire – explosion

209 killed in 1877 at Blantyre Mine in Lanarkshire, Scotland – explosion

According to the Coal Mining History Resource Centre, records from the early part of the last century show that there were accidents every year or so.

One of the more unusual accidents was at Egremont Mines, in Cumberland, in 1913. Although there was not a high death toll, its claim to fame is the length of time the survivors spent underground – five days – and the use of a borehole to keep them alive. Water flooded the mine, drowning one man as he tried to escape. But two others managed to scramble to an elevated position near a borehole, down which they were lowered food and drink – and even a shamrock on St Patrick's Day by their priest – while a rescue operation was planned.

More recent accidents

In March 1979, at Golborne Colliery, near Wigan in Lancashire, three men were killed when a fireball shot 200 yards along a tunnel. The explosion was caused by a build-up of methane gas which somehow ignited 1,800ft underground.

In 1993, three men were killed when a section of roof fell down at Bilsthorpe Colliery in Nottinghamshire. That accident – 18 years ago – was the last significant mining disaster in Britain before the Gleision incident.

With so few mines still operating in the UK, most accidents take place in developing countries with questionable safety records, particularly China. However, two Scottish men were among 29 miners killed in the Pike River Mine explosions in New Zealand in 2010.

working conditions which mean you cannot use big machinery like the old National Coal Board mines did."

The Workings

Following the main drift further inbye, the roadways are timber-supported, and lead to the current workings, deep under the hillside. They work a modified pillar and stall system in the 2 feet 6 inch Ynisarwed seam, and the coal face workers work kneeling or lying down. Coal is cut by drilling and blasting within a stall and removing the fractured coal with picks. It is then hand-filled by the miners onto a conveyor belt running down the back of the face, which takes it to the loading point in the main gate.

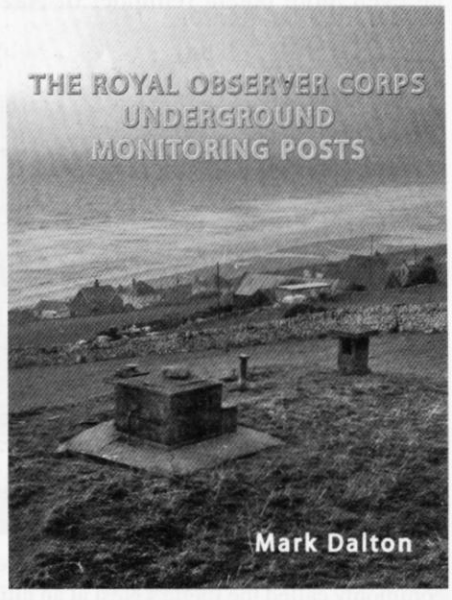
Manpower & Production

In 2001, there were about seven men at Gleision, including the mine owner who himself worked underground. It is a safety lamp mine with severe water problems which require the use of a powerful sump pump. The combined problems of water and gas can cause disruption to production and development. Production, in 2001, was about 200 tonnes per week

Book review

The Royal Observer Corps Underground Monitoring Posts

by Mark Dalton



Hardback 224 pages, 190mm x 250mm
ISBN: 978 0 9564405 5 6
Price: £22.95 post free to UK mainland addresses
Available from Folly Books 27 Farleigh Rise, Monkton Farleigh, Bradford on Avon, Wiltshire, BA15 2QP

The Royal Observer Corps was the volunteer organisation that watched the skies of Britain during the dark days of Second World War, reporting and tracking enemy aircraft and helping to win the Battle of Britain. What happened after the end of that conflict is less well known, with the Corps becoming the front line in a new kind of war; the Cold War.

In 1963 it was revealed that a powerful new radar system had become operational on Fylingdales Moor in North Yorkshire. This could detect the launch of Soviet ballistic missiles and allow a warning to be given to the population. The 'golf ball' radomes at Fylingdales and the 'Four Minute Warning' they provided are probably the most lasting icons of this nation's Cold War legacy.

While it was accepted that there was no defence against ballistic missiles, successive governments understood that many millions would still survive away from the impact zones if there was adequate warning and time to take shelter. The confirmation of such a strike and the extent and power of the weapons used were also key to both military and civilian organisations. Further lives could be saved if the ensuing radioactive fallout was tracked and warnings given.

To facilitate this, over 1,500 blast and radiation-protected, three-man underground monitoring posts were built during the late 1950s and early 1960s. This huge building program resulted in posts being built approximately eight miles apart in a network stretching across the entire country.

Provided with simple, reliable and robust instruments, and reporting back through larger Group and Sector control bunkers, the posts could warn the public and provide accurate data about nuclear explosions and radioactive fallout. This allowed the government to build up an accurate post attack picture of the whole country.

This book recounts the detailed history of the underground posts, their equipment and the crews that operated them, from their inception in 1956 to their closure in 1991. It also chronicles the fate of the many posts that have survived until the present day, either abandoned to vandals and natural decay, or lovingly restored.

The volume contains approximately 500 colour and black and white archive photographs and plans accompanied by comprehensive captions and an authoritative text.

Topics covered include:

- The origins of the Royal Observer Corps
- The ROC in the nuclear role
- The monitoring post network
- Manning the posts and life in the ROC
- Equipment
- Restored posts
- Abandoned posts.

The sections on equipment, abandoned posts and restored posts are extremely comprehensive and form the major part of the book.

Mark has been a member of Subterranea Britannica since 2004 and has written a number of features for *Subterranea* on Cold War sites. The late Derek Wood's book *Attack Warning Red* has always been considered the 'bible' for anyone with an interest in the Royal Observer Corps. Although Marks's book deals exclusively with the Cold War functions of the Corps, it deserves a place alongside the 'bible' on any book-shelf. I can highly recommend it.

Nick Catford

The Other Führerbunker

by Julian Allason

Where Eagles dare

A finger points to the sky. Far above the lake an eagle wheels on a mountain updraught, wings outstretched. Around me Bavarians fall silent, eyes aloft. It is a poignant moment. For behind us, crowning the peak is the Eagle's Nest, Hitler's sole surviving house, built for the Reichschancellor as a fiftieth birthday present in April 1939. What many of them may not know is that there is an even more potent reminder of Nazi doings beneath our feet.

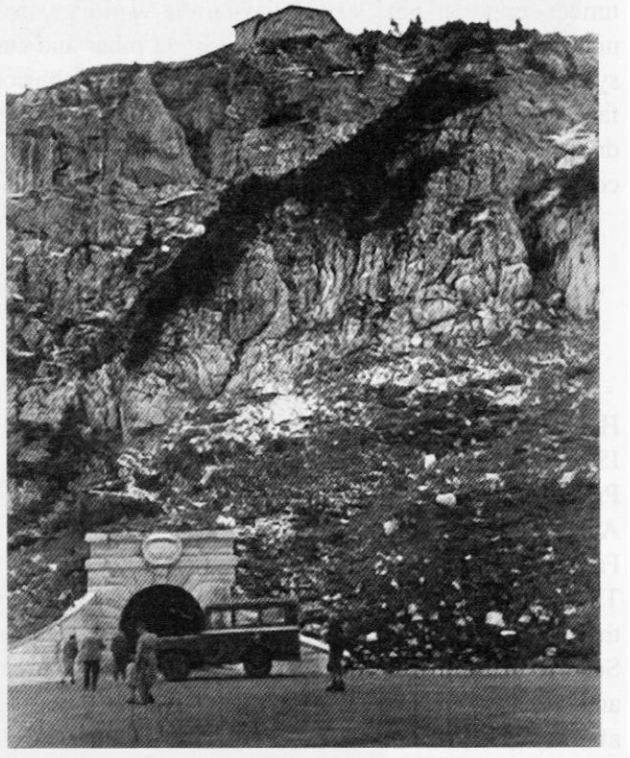
The Kehlsteinhaus – also known as Hitler's tea room but commonly called the Eagle's Nest at an altitude of 6,017 feet. Photo Tim Robinson

Long before Hitler's adoption of the Obersalzburg as the playground of the Nazi top brass in 1923, he had retreated to this enchanting alpine countryside to write 'Mein Kampf' (My Masterplan). Twenty minutes' drive from Austria's musical capital of Salzburg, and almost as far south as one can venture in Germany; it is a landscape familiar to all who have watched *The Sound of Music*. Chalets cluster in hamlets embraced by mountain pasture, while the romantic river town of Berchtesgaden is a living memorial to "mad" King Ludwig II of Bavaria, creator of the fairytale castle of Neuschwanstein (said to be Walt Disney's castellar inspiration).

Today the region has everything in the way of atmosphere and sites to attract Sub-Britters. It is well served by accommodation from mountain cabins to comfortable small hotels, and the 90-minute flight from the UK to Salzburg makes it accessible for a long weekend. English is widely spoken and children are welcome: action facilities to amuse them include canyoning and an exciting new toboggan run. For longer stays car hire is suggested as the excellent local bus service stops early.

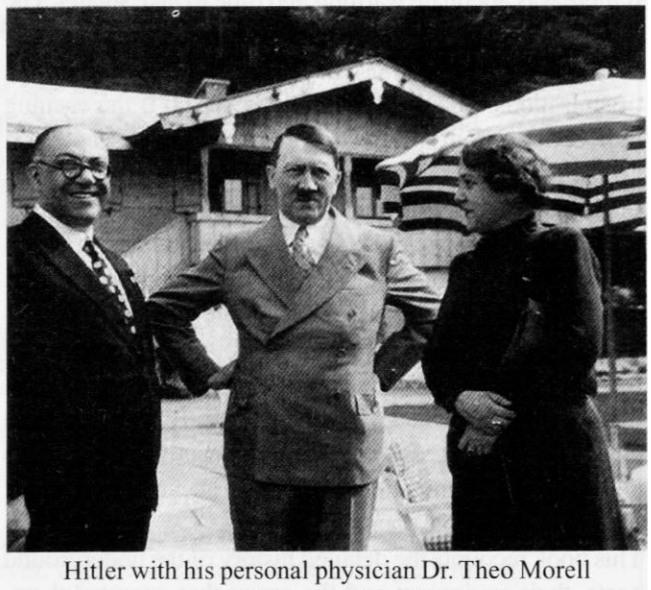
Echoes of history

Back on the lakeside we board an electric motorboat to cruise the Königssee, or King's Lake, under a blue sky broken only by puffs of white cloud – and that soaring

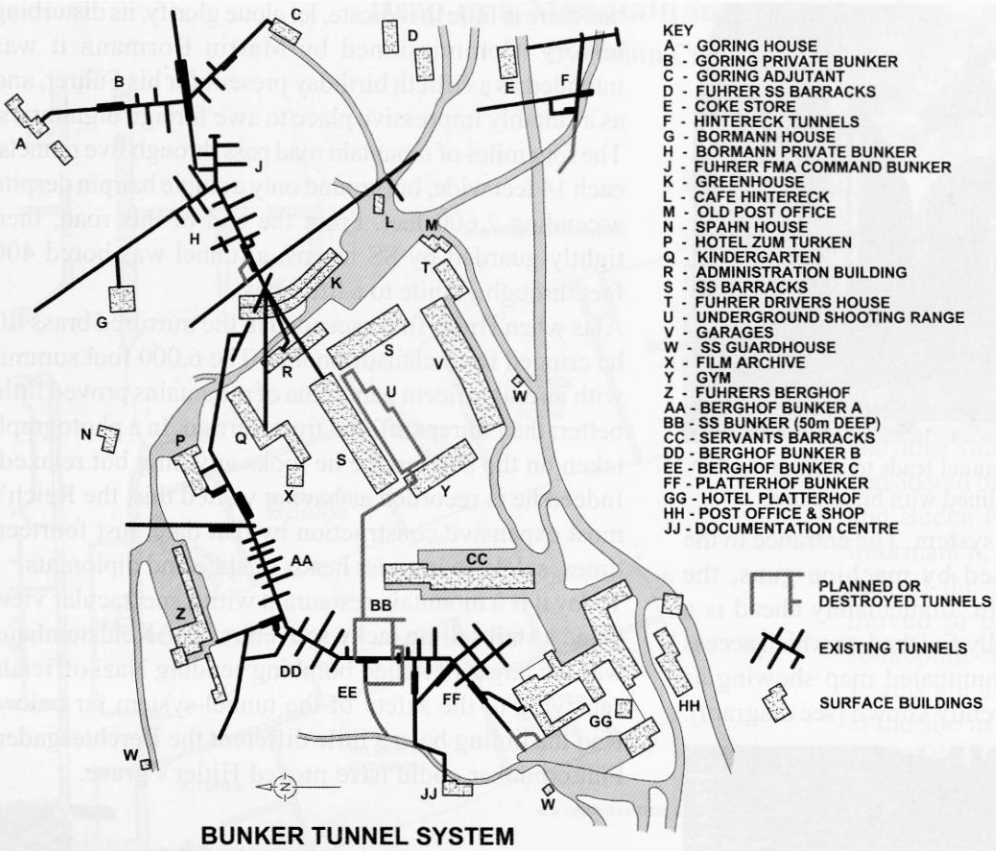


The Eagle's Nest perched 390 feet above its entrance tunnel – seen in 1945

eagle. The boat glides to a stop before a wall of rock. Playing a battered instrument the captain directs the first few bars of a trumpet voluntary towards the cliff, from which a triple echo returns. "A grenade creates seven echoes," whispers my local pal, Michael, with a conspiratorial grin. On the lake's northern bank stands the onion-domed church of St Bartholomew, the adjoining Augustinian priory happily converted into a restaurant serving local fish and excellent beer. A five-foot long trout glares down at us from a wall cabinet.



Hitler with his personal physician Dr. Theo Morell seen on the steps of the Berghof


KEY
A - GORING HOUSE
B - GORING PRIVATE BUNKER
C - GORING ADJUTANT
D - FUHRER SS BARRACKS
E - COKE STORE
F - HINTERECK TUNNELS
G - BORMANN HOUSE
H - BORMANN PRIVATE BUNKER
J - FUHRER FMA COMMAND BUNKER
K - GREENHOUSE
L - CAFE HINTERECK
M - OLD POST OFFICE
N - SPAHN HOUSE
P - HOTEL ZUM TURKEN
Q - KINDERGARTEN
R - ADMINISTRATION BUILDING
S - SS BARRACKS
T - FUHRER DRIVERS HOUSE
U - UNDERGROUND SHOOTING RANGE
V - GARAGES
W - SS GUARDHOUSE
X - FILM ARCHIVE
Y - GYM
Z - FUHRERS BERGHOF
AA - BERGHOF BUNKER A
BB - SS BUNKER (50m DEEP)
CC - SERVANTS BARRACKS
DD - BERGHOF BUNKER B
EE - BERGHOF BUNKER C
FF - PLATTERHOF BUNKER
GG - HOTEL PLATTERHOF
HH - POST OFFICE & SHOP
JJ - DOCUMENTATION CENTRE
PLANNED OR DESTROYED TUNNELS
EXISTING TUNNELS
SURFACE BUILDINGS

BUNKER TUNNEL SYSTEM OBERSALZBERG

Drawn by Tim Robinson

Berchtesgaden, nine hundred years old, traffic-free, and resembling the set for a Mozart opera, has restaurants aplenty, the cuisine divided between hearty Bavarian fare – magnificent hams, blood sausages – and more refined Austrian dishes like Wiener Schnitzel (thin veal fillets breaded and pan-fried). From the cathedral wedding guests spill out, all in traditional dress. Two tailors' shops in the square are busy making bespoke collarless *loden* jackets with antler buttons and green trim. Such is Michael's laughter that I abandon the idea of lederhosen, suede shorts with decorated braces still widely worn hereabouts and rarely cleaned.

The railway station remains a monument to the Nazi triumphal style popularised by Albert Speer. Hitler would travel here aboard his *Führersonderzug,* a special train also designed and equipped to serve as a mobile headquarters. His cronies, including Goebbels and Himmler, put up at the nearby Berchtesgadener Hof Hotel, recently demolished. Goering and Bormann had built villas of their own on a dramatic site at the foot of the Obersalzburg commanding a panorama of valley and mountains a mile outside the town, but were not inclined to offer hospitality.

Underground refuges

If money were no object the place to stay would be at this very spot, now occupied by the InterContinental Hotel Berchtesgaden. Every guestroom in the spectacular modern horseshoe-shaped building enjoys a vista, some of them up towards the Eagle's Nest. Its foundations, however, conceal mysteries of their own. For beneath it run Goering's bunker and Bormann's escape tunnels. The chalets they both built have long since been blown up, likewise the Berghof, Hitler's own country seat. Today only authorised officials of the Bavarian government and the hotel's surveyors are permitted to access the tunnels, though the strongly secured entrances exist in the hotel's lower basement. The history is unflinchingly displayed at Obersalzburg Documentation Centre. It is here that one gains admittance to an extensive network of

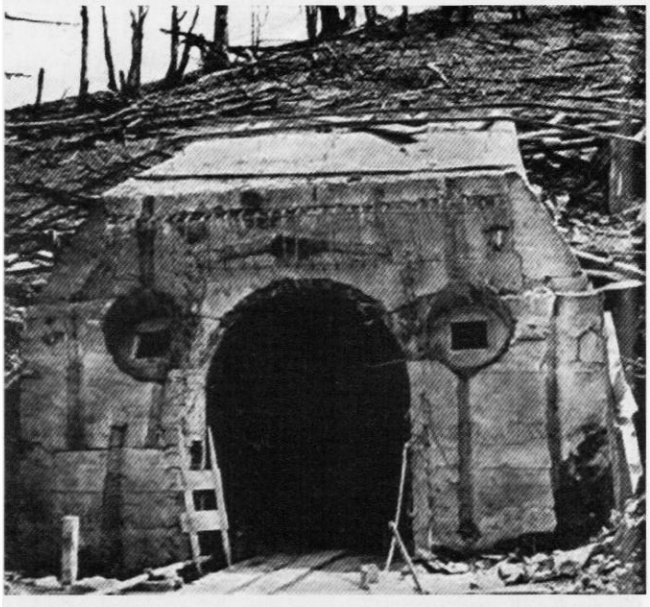
Hitler's country house, the Berghof in 1945. The principal entrance to the bunker was through a door at the rear of Berghof

tunnels and underground command centres built for the leadership. More tunnels can be accessed from the Hotel zum Türfen, now returned to its rightful owners after Nazi confiscation. To enter this unaltered world of concealed shafts and subterranean machine-gun nests is to approach very close to the regime's heart of darkness. Graffiti dated 5 May 1945 records the bunkers' capture by American and French troops.

From the Documentation Centre entry to the main part of the complex still open is down a ramp lined with information panels in German, before admittance to the

The 406-foot-long entrance tunnel leads to a lift up to the Eagle's Nest. The lift is lined with brass panels

Platterhof/Gästehaus tunnel system. The entrance to the first corridors was protected by machine guns, the embrasures for which remain. Immediately ahead is a high, wide chamber, never fully finished, to which access is barred. Before it is an illuminated map showing as much of the system as is currently known [see diagram].



Emergency exit from Platterhof tunnel system in 1945

At this point one forks right down a gallery to join a network of tunnels and chambers, construction of which began in 1943. Connected to it are rooms built and tastefully decorated for the Führer, Eva Braun, and Dr Theo Morell, Hitler's personal physician. The principal entrance to this Führerbunker is recorded as being through a doorway in the retaining wall at the rear of his country house, the Berghof. A further tunnel system was planned 40 feet lower but never built. An unfinished lift shaft remains as do the mounts for its machinery and fixings for power and ventilation equipment.

A present from the past

The local inhabitants seek neither to hide the past and what was inflicted upon them, nor to profit from it. As one approaches the Kehlsteinhaus or Eagle's Nest by bus there is little to indicate, let alone glorify, its disturbing history. Commissioned by Martin Bormann it was intended as a fiftieth birthday present for his Führer, and as a suitably impressive place to awe foreign dignitaries. The four miles of mountain road pass through five tunnels, each 14 feet wide, but around only a single hairpin despite ascending 2,600 feet. From the end of this road, then tightly guarded by SS troops, a tunnel was bored 400 feet through granite to a lift lobby.

Alas when Hitler first ascended in the mirrored brass lift he cringed from claustrophobia. The 6,000 foot summit with its magnificent panorama of mountains proved little better: the Führer suffered from vertigo. In a photograph taken on the sun terrace he looks anything but relaxed. Indeed he is recorded as having visited this, the Reich's most expensive construction by that date, just fourteen times, solely to impress heads of state and diplomats.

Today it is a mountain restaurant with a spectacular view – and a stall selling tacky souvenirs. The Kehlsteinhaus was the target of Allied bombing sending Nazi officials scurrying to the safety of the tunnel system far below. Had the timing been a little different the Berchtesgaden Führerbunker could have proved Hitler's grave.

Hitler and Eva Braun relaxing in the Berghof

GETTING THERE

British Airways flies from Gatwick to Salzburg
Ryanair flies from Stansted to Salzburg

WHAT TO SEE

Königssee cruise: www.koenigssee.com
Berchtesgaden old town: www.berchtesgadener-land.info
Obersalzburg Dokumentation bunkers: www.obersalzberg.de
The Eagle's Nest: www.eagles-nest-historical-tours.com
Berchtesgaden Salt Mine: www.salzzeitreise.de

SEASONS

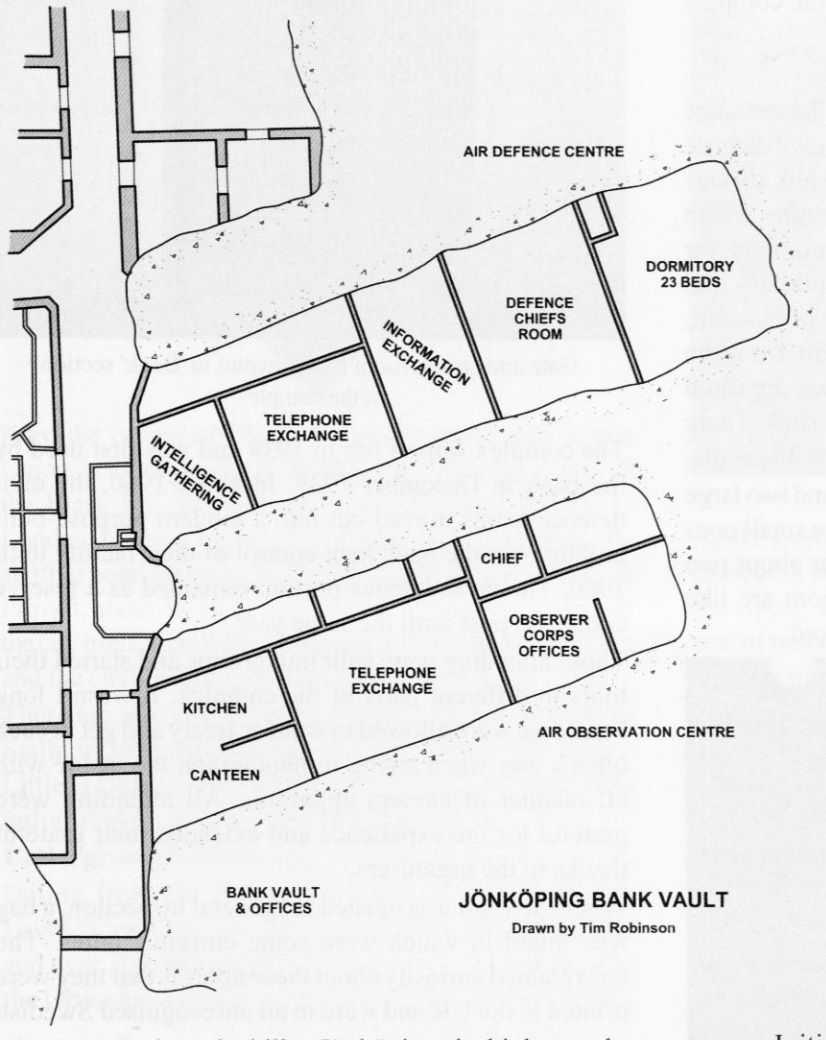
Best time to visit is May to October. August is crowded.

FURTHER INFO

www.berchtesgadener-land.info
www.thirdreichruins.com/bunkers.htm

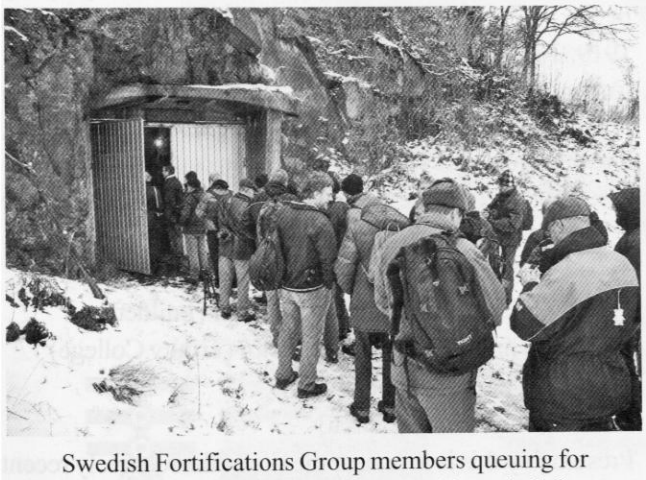
Deep in a Mountain in south Sweden

by Robin Cherry



The Town Park on the hill at Jönköping sits high over the town. The generous snowfall during the night, the first of the year, makes the going difficult. This is an area with luxurious housing and is known among locals as the "cream shelf". It is early on a Saturday morning and the snow has painted everything white.

Unusually there is now a large group of people gathered around a hitherto secret location; we are here because the Swedish Historical Fortifications Society has arranged a study day and visit to two of Jönköping's mountain facilities.



Swedish Fortifications Group members queuing for their visit. Community facilities inside to the left, Ex-Bank area straight on

Crown Jewels

The attractive and expensive houses were hardly given a thought as our thoughts were focussed on the facilities *inside* the mountain. Before World War II, the Swedish National Bank had looked for suitable places to store its gold reserves and other valuable objects. Other locations considered but discounted were Karlsborg and Boden Fort. According to available information, in December 1939 the largest part of the Swedish gold reserves was moved to the storage facility here at Jönköping. Some of the Swedish Crown Jewels are also said to have been stored at the site in later years.

Inside the same complex were the headquarters of the air-raid and air-defence authorities. In addition, room was made available in safe-deposit boxes for further storage of valuable items for those interested, including those from countries occupied by the Germans. It was an unusual but by no means unique arrangement to have high-security storage and civil defence in the same building space. Initially, the bank and the defence parts were totally separate but later on a connecting tunnel was made.

This civil defence portion included the Swedish version of the Royal Observer Corps, where reports from visual sightings were gathered together to form intelligence for air defence purposes and for public warnings. At the end of the war, with the atom bomb threatening, other facilities were built elsewhere and the role of the Jönköping mountainside bunkers partly disappeared.

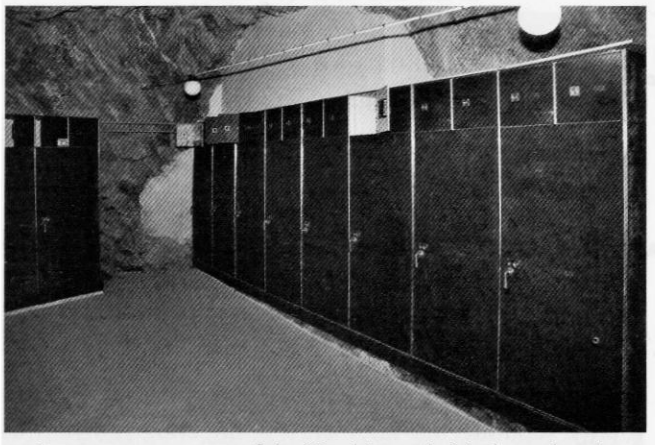
Papers left in the Air Defence section

The original entry door was large enough for a van or small lorry to be backed in for loading and unloading, but at a later date another entry was built into the complex for pedestrians.

Time Capsule

On entry, one comes into a large church-like entrance hall with the Bank part across the hall and the civil defence part down a tunnel to the left. Turning to the left, service facilities such as ventilation are passed first after which various rooms are built where all the equipment for communications and office space for the military and civil defence people are located. At the time of our visit, the rooms were a time capsule where, apart from the accumulation of decades of dust, the workers appeared to have just left as if it was the end of their shift. There appeared to have been places all told for about 35 people.

The Bank's section consisted of three small and two large rooms on both sides of a central corridor. The small ones are about fifty square metres and the larger about two hundred sq m. The outer doors to each room are like safe doors, behind which are bars, also locked.



Inner sanctum part of the 'Bank' area behind previously locked and fortified doors. The safe deposit boxes are small and large. One or two labels remained describing previous contents such as deeds of buildings

Gate and strong room door beyond to 'Bank' section of the complex

The complex started life in 1938 and was first used by the bank in December 1939. In about 1960, the civil defence teams moved out into a modern purpose-built building but the bank kept control of their facility until 1980. The civil defence portion remained as a reserve command post until the same year.

Those attending were split into groups and started their tours in different parts of the complex. It wasn't long before we were allowed to wander freely and get in each other's way when trying to photograph the inside with all manner of camera apparatus. All attending were grateful for the experience and extended their grateful thanks to the organisers.

When the vault was opened for general inspection, a bag was found in which were some currency notes. The unexplained curiosity about these notes is that they were printed in the UK and were in an unrecognised Swedish currency.

Information taken from *Fort and Bunker* magazine February 2011 and from the personal description of an attendee.

Subsidence in 1897 at Maidenstone Hill, Blackheath, SE London

Morden College (almshouses) was established by the wealthy merchant John Morden [1623 – 1708] on an estate at Blackheath purchased by him in 1669, in a building attributed to Christopher Wren. At first it was to accommodate 12 'decayed merchants' the number being increased to 40 after his death (Morden was created 1st Baronet in 1688).

At a meeting of the Trustees of Morden College, Blackheath, held at the Guildhall on October 7 1897, The [College] Surveyor Thomas Barnes Williams reported that on Sunday the 5th ultimo a subsidence of ground took place immediately in front of N° 15 College Place West, Blackheath, which involved the front portion of the house, the forecourt, footpath and a considerable portion of the roadway leaving a cavity some fifteen feet deep, and ten feet or more in diameter. A similar subsidence was stated to have occurred 18 years ago [1879] and these phenomena were attributed to caves in the ground. The premises were held with other property by the Assignees of Charles Jones for a term expiring in 1919. The Lessee was making good the damage.

College Place West, Blackheath, is listed in Kelly's *London Suburban Directory*, 1896 [*Part 4. Southern Localities*], Greenwich, page 208, as follows:

- [College place west, Maidenstone hill, College place east to Blackheath hill.
- [4 Martin Miss Jane, dressmaker
- [17 Benjamin Herbert Frederick, builder
- [Whife James, cab proprietor (Trinity College)
- [National Schools
- [Holy Trinity Church]

Presumably this is at or near the site of the relatively recent collapse of parts of the A2 at Blackheath Hill into abandoned chalk mines.

Underground in Kiev – Ancient and Modern

by Stewart Wild

Voksalna station. Photo Silanov

Kiev, the capital of Ukraine, formerly part of the Soviet Union, is located some 1300 miles east of the UK, north of the Black Sea and at more or less the same latitude as London. It is well known to many Sub Brit members as the starting point for visits to Chernobyl and the ghost town of Pripyat, about 75 miles north, but our interest was more in the city itself, especially the ancient cave monastery of Lavra and the city's relatively modern Metro system.

There are also two "secret tunnels", started by order of Stalin in 1936 and apparently under the River Dnieper. Little is known about them, they are not easy to visit and unfortunately we didn't get the chance.

Underground monastery

Dating from the eleventh century, Kiev's Pecherska Lavra "Caves Monastery" is the city's major attraction, and over 100,000 pilgrims come every year from all over the Orthodox world to pray and worship in this complex.

Apart from the fine churches and several top-class museums on the surface, the main draw for Sub Brit is the upper and lower "caves", which are actually two sets of tunnels bored through the rock, and which contain a series of mummified saints arranged over a thousand years. There are over a hundred burials in the complex, the most recent dating from the last century.

Shortly after Christianity became the region's new state religion, St Anthony arrived in Kiev in 1051 from Mt Athos in Greece and settled in a cave overlooking the river. With the help of devoted follower St Theodosius, he enlarged the cave into an extensive underground network to accommodate more and more monks, who often spent an entire lifetime here in prayer, meditation and study,

secure from any distraction or persecution in the real world above.

The tunnel passages are around five feet wide and six feet high and contain living quarters and chapels that are not part of the experience. Visitors and pilgrims alike arm themselves with a lighted beeswax candle and shuffle along in the gloom (no torches or photography are permitted). Some side passages are reserved for genuine pilgrims to pray in silence.

The saints are in coffin-shaped boxes with glass lids and are covered so that the mummified remains – whatever state they're in – are not actually visible. During the Soviet era, when the authorities showed little regard for religion, the bodies were not covered, but a resurgence of belief and respect since Ukraine's independence means that they are now entirely shrouded in vestments.

The central hall between platforms at Zololitie Vorota station on the Syretsko-Pecherska Line

Photo reproduced from Wikipedia under creative commons licence

The two separate networks of tunnels or catacombs are known as the Near Caves (Upper) and Far Caves (Lower). The visit does not last long and one soon emerges into daylight lower down the hillside from the entrance in the church above. The whole complex is on the UNESCO World Heritage Register.

Kiev's Metro system

Kiev's answer to LUL dates from 1936, when it was the third such system planned in the old Soviet Union, after Moscow and St Petersburg. The company that built the Moscow subway also built Kiev's, so unsurprisingly there are similarities in design and style.

At present it comprises three lines, red, blue and green, opened in 1960, 1976 and 1989 respectively, with forty stations over a route length of 55km. About ninety percent of the stations are underground, with just five at the eastern end of the red line on the surface. Various extensions are under construction or planned, as is a new fourth line (yellow) running roughly northeast-southwest which will extend the network to around 70km.

Some of the city-centre stations are very grand, in the Moscow style, with wide platforms and vast corridors that were built to double as nuclear shelters if need be.

World's deepest station

The three interchange stations are huge underground complexes, with shops and kiosks and very long passages linking the platforms. Some stations are exceptionally deep, and we enjoyed exploring Arsenalna station on the red line, the deepest metro station in the world.

Claims for "world's deepest station" have also been made for Moscow's Park Pobedy station at 97 metres and St Petersburg's Admiralteyskaya station at 105 metres. The Pyongyang subway in secretive North Korea may also have some contenders – no one seems to know.

The Arsenalna station platforms are 107 metres below street level, linked by two long escalators with an offset landing between the two in the style of LUL's Northern Line station at Angel. However, whereas Angel's escalators whisk you from bottom to top in around three minutes, those at Arsenalna take nearly five minutes to get you into the fresh air.

Unidentified station.

Photo by Marco Cortesi

Another major difference with London Underground is the cost; a single ticket to anywhere on Kiev's system will cost you two hryvnia (about 16 pence). You buy a blue plastic token at the station and insert it into a slot that opens automatic gates, as in London. Some busy stations, however, have gates that stay open, but spring shut across your knees if you try to pass without inserting the plastic coin.

The system runs from around 0600hrs until midnight, and the six-car rolling stock is in the style of the New York subway system. There are digital timers at the end of each platform to inform passengers how long has passed since the previous train departed.

Overall however, maps and signage, which is in Roman letters and Cyrillic script, is not as good as in London, although there are announcements as the train approaches each station and the next station's name in Roman and Cyrillic appears – in between video clips and advertising – on a small roof-level screen in each carriage.

With a little effort, and a map, Kiev is an easy and worthwhile city to get around and explore underground, and there are some ancient trams and buses too.

JULES VERNE'S JOURNEY TO THE CENTER OF THE EARTH
1001 WONDERS!
The Lost City of Atlantis!
The Prehistoric Dimetrodons!
The Crater of Snaekells-Jokull!
The Subterranean Oceans!
1001 THRILLS!
The Giant Mushroom Forest!
The Stratum of Cinnabar!
Gargantuan Chameleons with 20 foot tongues!
Stalagmites and Stalactites!
STARRING
PAT BOONE · JAMES MASON
ARLENE DAHL · DIANE BAKER
COLOR by DE LUXE
CINEMASCOPE
PRODUCED BY CHARLES BRACKETT · DIRECTED BY HENRY LEVIN · WALTER REISCH
SCREENPLAY BY and CHARLES BRACKETT
20th Century-Fox
1959 Film poster

1. *Journey to the Centre of the Earth*

Jules Verne [1828–1905] was one of the world's first, and still best-known and widely-read, authors of science fiction. He was born in Nantes on 8 February 1828. After schooling in Nantes and Paris he commenced a career in writing plays and short stories, also working more rewardingly (probably, in financial terms) as a stockbroker.

His breakthrough as an author came with *Five weeks in a Balloon* (1863), *Journey to the Centre of the Earth* (1864), and *From the Earth to the Moon passage direct in 97 hours and 20 minutes* (1865). Amongst his better-known later works are *Twenty thousand leagues under the Sea* (1870), and *Around the World in 80 days* (1873).

In 1874 he moved to Amiens, where many of his possessions can be seen in an impressive museum dedicated to his memory in one of his former houses in the city. Amongst the contents of this house are his library (he based much of his writing on then-modern published science and travel books) and an array of his intricate models of fantastic flying machines, submarines, and the like, all of course predating the actual appearance of such things in real life. Verne died on 24 March 1905. His biography has been written by a grandson.

The *Journey* commences at the home of one Professor Otto Lidenbrock (born, we are told, about 1813), mineralogist and book-collector, of the Johannaeum at Hamburg, where his orphaned nephew Axel (who seems to be in his late teens or very early 20s) also lives. Axel's girlfriend Gräuben (17), who happens to be the Professor's godchild, also features in the story, but does not (of course) go underground. Ladies don't do such things!

The Professor discovers a loose scrap of parchment, bearing some sort of encoded message in runic characters, tucked into a bound manuscript of 1163 which he has just purchased. He fails to crack the code but, while he is out, Axel finds the secret, and is terrified by what he reads. It is directions for a route to the centre of the earth.

The nephew knows his geologically inclined uncle could hardly resist taking such a journey, and this is of course exactly what happens, with very little delay. The Professor and Axel take train to Denmark and ship to Iceland, the lost subterranean route having been revealed as commencing in the crater of Snaefellsjökull, a glacier-capped volcanic mountain readily visible across the sea from Reykjavík in fine weather.

Verne's description of the journey from Reykjavík to the foot of the glacier-topped volcano is an accurate representation of the terrain, still recognisable today (apart from there now being a gravel-surfaced road and wheeled internal-combustion engine vehicles instead of pack-ponies). Although Verne travelled widely, and owned at least two ocean-going yachts at various times, he never got to Iceland. However, his library doubtless contained a number of maps and books of travels to the mid-Atlantic island.

Arne Saknussemm, the supposed author of the runic message, instructed those wishing to follow in his footsteps as follows:

> *Descend the crater of the Jokul of Snäfell, that the shadow of Scartaris softly touches, before the kalends of July, bold traveller, and thou wilt reach the centre of the earth.*

Which I have done (well, the first bit, anyway!).

Verne's topographical description goes all wrong the moment they commence to climb the mountain (a little

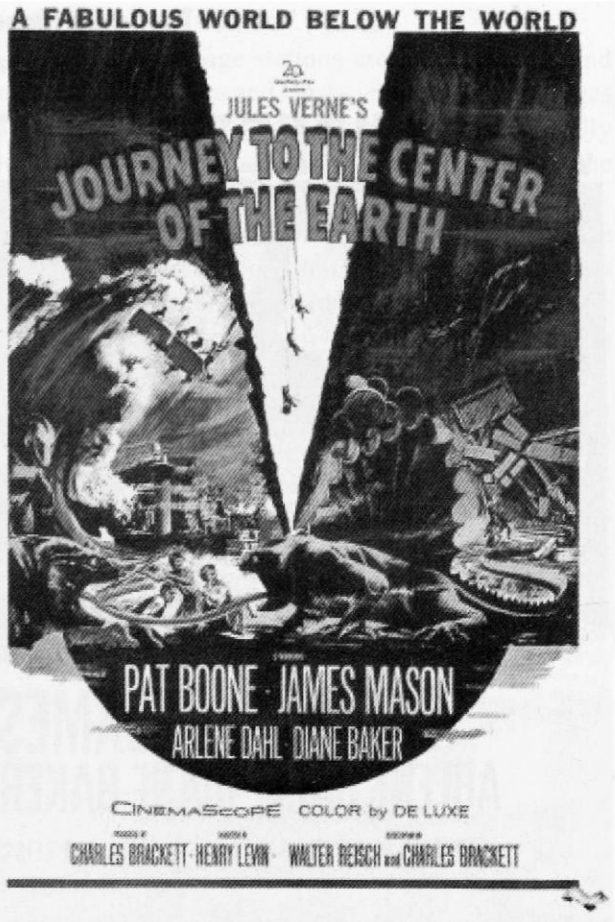
under 4,700 feet), and it is almost certain that no Icelanders or foreign travellers had ever done so, or left any written description of its upper reaches, although it is a perfectly easy climb over rocks, ice and snow apart from the last few hundred feet.

The Icelandic guide engaged by the party of two (the Professor and Axel), one Hans, conveniently knows which of the supposed three peaks is called Scartaris (an unlikely bit of knowledge for an Icelander with better things to do than climb mountains). There is then an exciting race between the weather, the sun, and the shadow of the named peak. As luck would have it (there wouldn't have been a story otherwise!) the clouds lift, and on exactly the right day the shadow falls on one of several vertical descents leading down from the floor of the crater.

From here on, it is all exciting stuff! Belief has to be suspended concerning the ability of three men (one of them aged 50) to carry food and water from 25 June, when they went underground, to some time in late August when they emerged (to their great surprise, assisted by a volcanic eruption) something like two thousand miles away on Stromboli. Nor indeed how they kept primitive electric lamps operating!

Verne recites the then current theories about whether or not the earth becomes hotter and hotter the deeper you go. He opted for the wrong answer, of course, so the explorers are not burned alive. His geology is all wrong as well – not that anybody in 1864 knew anything about the structure of the earth's crust, plate tectonics, and continental drift! Granite and gneiss are not to be expected underneath Iceland.

For an account of the fantastic adventures the party enjoyed, and in some cases did not enjoy, underground, you have to read the book! I recommend it.


A FABULOUS WORLD BELOW THE WORLD
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As it happens I have (unlike Verne) climbed Snaefellsjökull. It is an easy afternoon walk, on a good day, up from Ólafsvík, with superb views across central Iceland. There is no crater at the top (unless buried under what is left of the now steadily receding ice cap). Curiously, the week I returned from that particular expedition I had a letter from France, in which a group of would-be explorers sought my advice for a Jules Verne Expedition they were planning.

I was, at that time, Secretary to the sometime Anglo-Icelandic Field Research Group, an information-swapping organisation for University and school groups planning fieldwork expeditions. Whether, after I had told them there is no descendable crater, they nevertheless followed in their hero's footsteps I know not. I had been there, done that and there weren't any T-shirts at the top either.

References

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JULES-VERNE, Jean, 1976, *Jules Verne: a biography* [translated and adapted by Roger Greaves]. London: Macdonald & Jane's Publishers Ltd: 245pp [ISBN 0-356-08196-6] [Jean Jules-Verne is the author's grandson. His biography was first published, in French, by Librairie Hachette (Paris) in 1973.]

VERNE, Jules, 1864, *Voyage au Centre de la Terre*. Paris: Pierre-Jules Hertzel [Translated as *Journey to the Centre of the Earth*, the book has appeared in numerous editions in English from 1876 onwards and is still in print.]

VERNE, Jules, 1872, *Journey to the Centre of the Earth*. London: Griffith & Farran (the first of a number of English editions).

Stills from the 2008 film.

Subterranea Britannica

Notice of Annual General Meeting 2012

The AGM will be held on Saturday 21 April 2012, commencing at 10.00am at Imperial College, London, followed by the Spring Meeting

Documents for the AGM will be available on our website at www.subbrit.org.uk at least 28 days in advance of the meeting. Members will be emailed to advise when such documents are available

Those members who have registered to receive documents by post will be sent them when they become available

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Minutes of the AGM 2011 and EGM 2011 were printed in *Subterranea 27,* September 2011

Spring Meeting 2012

Saturday 21 April 2012, commencing at 10.20am at Imperial College, London

There will be the usual mix of interesting illustrated talks, including

* Rod Le Gear on Kent Below Ground
* Mark Dalton and John Shere on the Royal Observer Corps
* Charles Devereux on Crossrail

along with Members' contributions and a chance to meet and mingle with fellow enthusiasts

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***A paper Booking Form is enclosed with this issue of* Subterranea**

The programme & booking form will also be on our website

Please put the date in your 2012 diary now!

SOUTH TUNNEL
HEIGHT & WIDTH LIMITS
IN CENTRE TUNNEL